

kilobaudTM

The Small Computer Magazine

ISSUE #9

September 1977

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SWTPC announces first dual minifloppy kit under \$1,000



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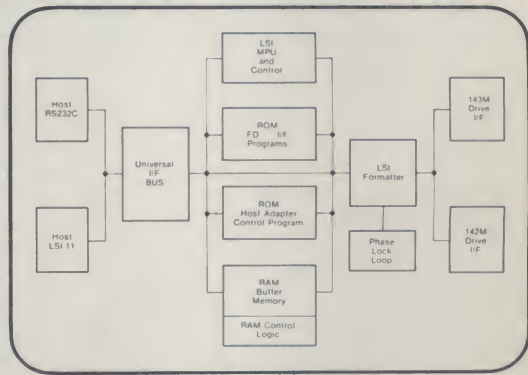
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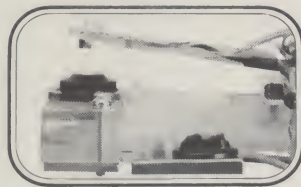
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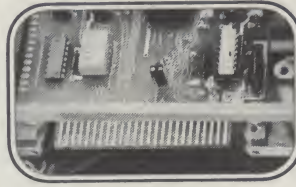
The roots of our floppy family



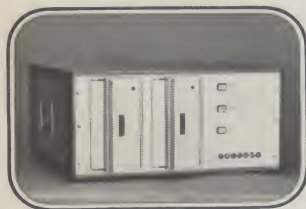
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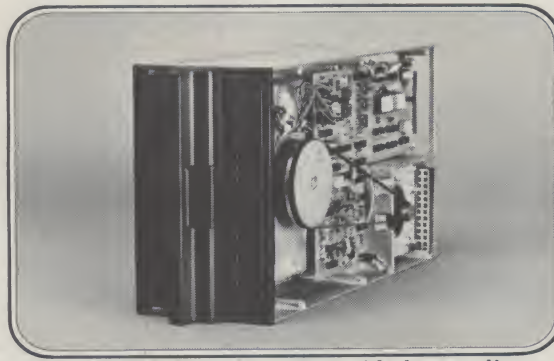
Dual head



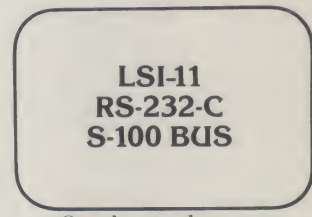
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PUBLISHER'S REMARKS

Wayne Green

Computerfests

There seems to be growing evidence that the number of computer hobbyists is leveling off ... as I predicted. It makes sense if you step back and think about it for a while. Unfortunately most of the people in the industry are wrapped up with their day-to-day problems and haven't given a lot of thought to the long run situation.

The computer hobby is particularly demanding ... it requires time, money, intelligence, a pioneering spirit, and a willingness to overcome formidable obstacles. Right off the top I think those prerequisites are enough to put a lid on the hobby growth. Just as a measure of comparison, when I look at the ease with which people can get a ham license and then note how few people have the stamina to overcome even that lowly barrier, I am not encouraged to imagine millions enduring the rigors of computer acquaintance on much more than a superficial level ... perhaps we can agree to call a superficial or dilettante approach "personal computing" as opposed to hobby computing.

The Cleveland Computerfest was well organized. There were about fifty exhibits and enough people passing through to keep things humming. It was in no way jammed, and attendance was not substantially improved over last year. *Kilobaud* was there, as was *Interface*. *Byte* was quite noticeably *not* there, leading many people to ask us if they are in trouble or just not further interested in supporting the hobbyists. They didn't bother to support the Atlanta computerfest either!

The Atlanta Hamfest/Computerfest drew a lot larger crowd than last year. There were over 150 booths, and the largest Sunday attendance I've ever seen ... still, there were not as many newcomers to computing as might be hoped. Those who did come had a good time ... and I suspect that most of the computer hobbyists from the Southeast did come.

How Can We Get More Hobbyists?

There are a number of people who feel that articles such as are being published in *Personal Computing*, *ROM*, and even *Creative Computing* will get people interested in hobby computing. I'm not convinced of this, nor have I been able to find any computer store owners who see this working. The reports I'm getting are that interest in these non-specific magazines is not intense and they are cutting back their bulk orders for their stores.

I suspect that if we could provide the simple basic information people need to

get started in computing that we would have a lot more enthusiasts. When I look over the articles being submitted to *Kilobaud* for publication I realize how difficult it is for newcomers to even get an inkling of what is going on.

For instance ... just about all of us have seen or heard about the Cromemco Dazzler, but how many of us understand how it works or just what it can do? A recently submitted article involved a program for plotting on the unit. This was a wonderful opportunity for the author to do a thorough job of covering the Dazzler for us. Instead, I got the feeling when trying to read the article that I had walked in on the middle of the course. Nothing made much sense. It undoubtedly would be fine for someone already familiar with the Dazzler, but it left me high and dry.

I've been trying to get someone to write an article on the Dazzler ... how it works ... what it can do ... when we would use it ... what programs we need for it and how to write them. I've seen it do Life games and some pretty patterns. Is that *all* it's good for? Apple and ISC also have some color graphics which could stand some revelation too.

The COMPUTERMANIA Concept

In addition to making it easier for people who get

interested enough in computers to try and learn via a magazine, we do need to think in terms of attracting a lot more people to computing. This is the basic concept of **COMPUTERMANIA**. I don't know whether this is going to work or not, but it is worth a big try.

COMPUTERMANIA is an exposition of microcomputers with the advertising and promotion aimed at the general public rather than just the current hobbyists. So far we have seen computerfests promoted almost entirely within the hobby ... in the hobby magazines. With **COMPUTERMANIA**, in addition to posters with pre-registration coupons in every computer store in the country and in every ham store in the East, plus in as many colleges and universities in the East as can be managed, there will be ads in *Time*, *Newsweek*, *Business Week*, *Boston*, *The New Englander*, etc.

The blitz radio and television advertising technique has worked well for movies and is worth a try for an exhibition. Plans are being made for a couple of thousand spot announcements during the week before the show — saturation advertising.

If this all works and we are able to bring people out to see microcomputers in large numbers, the next step is to do our best to communicate with these people ... not lose them by sticking to computer buzzword put-

Here are some photos of the Atlanta Computerfest taken by Barry Mittan of Objective Design, Inc. With about 7,000 attending and 150 booths of exhibits, it was a crowded show.



Objective Design, Inc.



Atlanta Microcomputerist Hobby Club.



Harry Garland . . . ask to see the insides of the Z-2 at **COMPUTERMANIA**.

offs.

Hobbyists can help a lot with this project. In addition to getting to see the latest in what's available at the exposition, they can try to act as interpreters between the public and manufacturers who just can't communicate. We just might end up with a lot more hobbyists in the long run . . . and the more of us there are the more equipment and programs we'll all have. We have nothing whatever to gain from keeping computing exclusive.

Cassette Programs

As we move closer to spawning a lot of programs on cassettes to help make our little computers do things, we keep running into problems which call for standardization. It would make our lives a lot simpler if there were one cassette standard . . . one BASIC . . . a standardized system of I/O addresses . . . etc.

The concept, as I explain it to non-computer people, is this: You can compare a computer with a high fidelity

Almost all of us wish we had a Cromemco Dazzler. But that isn't all Cromemco and its president Harry Garland are up to. You'll be reading more and seeing the Z-2 microcomputer system. Here's Harry showing the super heavy-duty power supply he's building into the Z-2 system. The case is built more like a Mosler safe than a computer, with the intention of keeping the RFI inside the box instead of raising the devil with television and radio reception.

Harry showed how every wire coming out was filtered. Even more impressive was the new Cromemco motherboard used in the Z-2 system . . . it has 50 of the 100 lines on top of the board and the other 50 on the bottom, with wide ground islands between each line of the bus. This helps keep noise down on the system, and reduces the RFI too.



Here's Michael Stone, the director of marketing for Imsai. The newly announced megabyte memory system has shaken up the market . . . and focused more attention on the rapidly dropping prices of massive memories.

ty system — without program material it doesn't do anything. A hi-fi requires phonograph records with music, speech, sounds, etc., on them before you have any result. The same goes for computers — without programs they do nothing. It is my intention to turn out the programs to enable computers to be usable . . . to have them for sale through computer stores in hundreds and then in thousands.

What kinds of programs will be sold? In addition to such obvious ones as business programs for payroll, inventory, accounts receivable, mailing lists, etc., (and there will be all types of each of these), there will be programs to teach every course which is available in school . . . from simple addition to decyphering hieroglyphics. There'll be programs for handling most math situations, for lawyers, real estate people, dentists, etc. There is virtually no end to the number of programs we can sell.

Where will they all come from? With a 20% royalty going back to the programmer who writes the programs being sold, the answer is they will come from anyone interested in making a lot of money. With 50,000 computer stores selling an average of 100 programs a day . . . at an average of \$5 each, this means royalty payments on the order of \$3.3 million a day. That could be low. A best-selling program, like a best-selling book, could make a programmer independently wealthy. There may be a lot of competition there.

But what about bootlegging? It's possible, to be sure . . . but between setting a relatively low price on each program . . . supplying good documentation with it . . . and copyright, it should not be a serious problem. You've probably noted that even though cassettes and cassette recorders are ubiquitous, record sales have not been seriously hurt. Most

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EDITOR'S REMARKS

John Craig

Surplus from the Biggies

Many of those among our ranks are professional computer types as well as hobbyists. Most of you falling into that category work for large (and sometimes not-so-large) computer and peripheral manufacturers. Let's discuss for a moment a shameful situation which exists within most of these companies... the wasteful disposal of surplus and obsolete equipment. It's shameful because in most cases this equipment is sold to junk dealers *by the pound!*

There is, of course, a very good reason why companies choose to dispose of equipment in this manner. They want to insure that it doesn't get reconditioned and sold again... in competition with their new products. In spite of this reasoning (which is perfectly valid) there must be a way for the hobbyists to take advantage of the situation and get in on some of the good buys. I'm not

going to be offering any solutions here because I've never done it. But, I would like very much to hear from those who have checked into the situation to see if there isn't some way for clubs or individuals to purchase some of these goodies.

The goodies I'm talking about range from complete computers down to surplus PC boards. Now, getting hold of PC boards to rob the ICs and discrete components isn't something that appeals to me... but robbing them of IC sockets is another thing! I probably have a 5 to 10 year supply of wire-wrap sockets lying around my shop simply because I used to work for a minicomputer manufacturer who threw an enormous quantity (50-gallon drums full) of wire-wrapped boards away at one time... and invited the employees to help themselves. As a matter of fact, they *always* had 50-gallon drums filled with surplus PC boards! One time they did a run of wire-wrap prototyping boards which had a slight flaw. There were more of those thrown away than all the interested

scavengers could even carry off!

The sockets and the PC boards are just minor examples of the thousands of dollars worth of equipment disposed of monthly by companies all over the country. Why don't you get busy, as a club project (or individual), and approach these companies and see if there is something that can be worked out as far as your getting a chance to bid on this equipment along with those junk dealers? And, like I said before, let us know what kind of obstacles (and success) you encounter.

Advertising?

Carl Warren wrote an article (which appeared in *KB#6*) describing a billing system he developed. Shortly after it was published he received an offer from a company to put him under contract to do similar software development (small business programs). That wasn't his objective in writing the article... but it sure starts you to thinking, doesn't it?

NCC

From all the reports I've received the recent National Computer Conference

(NCC) in Dallas had a lot of interesting things to see and people to meet. I only wish I could have made it. I want to extend a special thanks to the Personal Computing Committee for inviting me to speak and to the Conference Committee for the invitation to their get-together. I certainly hope the invitations will be renewed next year because I will definitely be in Anaheim. See you there!

Miscellaneous

Red Stolle, and his wife Sue, live on a boat down in the Carribean. During a recent trip around the U.S. they stopped in for a visit which I enjoyed very much. Red hasn't bought his system yet, and the main purpose behind the tour was to check out all the computer stores and manufacturers from here to kingdom come in an attempt to reach a decision. He's got an interesting "problem" because he lives in a 12 V dc environment. He can't just take that computer home and plug it in like most of us can (apparently the marinas down there aren't quite as sophisticated as those in the U.S.). Before going home he decided on, and purchased, a KIM-1 and an Intersil Intercept Jr. (Another one of those lucky retirees who have computers as a hobby!)

THE HEATHKIT FORUM

Charles Floto

Why all the excitement about the Heath Company's computer kits? It's been going on for over two years now. The Micro-8 Computer User Group Newsletter dated August 28, 1975 has a page-two item: "Wouldn't it

be neat to know what Heathkit has on the boards. Word around the Bay Area was that Heathkit engineers were making the rounds of the semiconductor manufacturers recently looking at microprocessors."

Part of the answer is suggested by a letter I recently received from New Jersey. Philip J. Bird says: "Having been a Heathkit buff for some 7 or 8 years, I have frequently suggested to them that I was interested in home computer kits."

And from Utah William D. Bradley writes: "I have used Heath gear for many years in hobby, industry and government work areas. It has been considerably improved in capabilities since 1950 when I built my first kits." (Anyone out there been building Heathkits longer than that?)

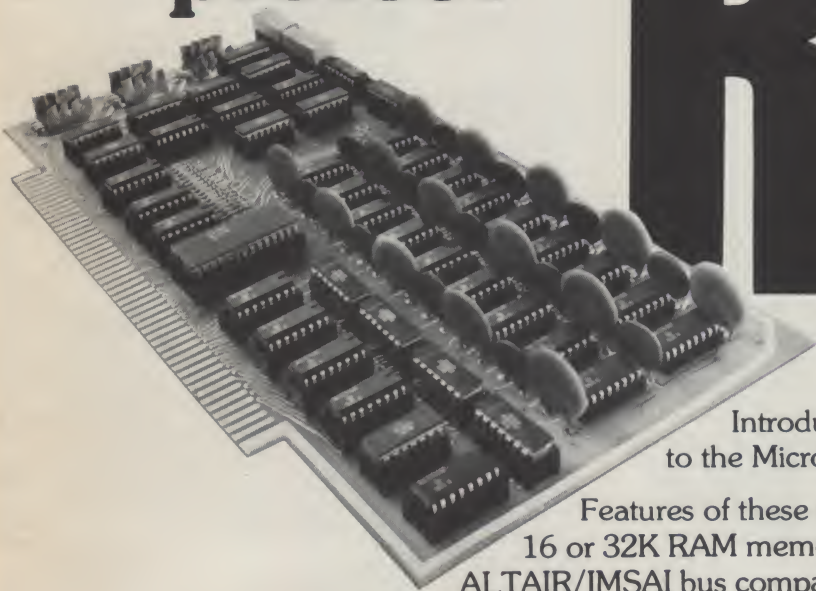
Apparently a lot of hobbyists share the attitude of a professional in electronics and data processing, Florida's Michael A. Francis: "I have held off on any microprocessor development for my personal use until Heath makes the big introduction." He continues: "I have been building, using, fixing and recommending Heath since 1955. And, I will be building one of Heath's first micro kits with its peripherals if my wife authorizes the expenditures..."

The long-awaited official

continued on page 19

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LEGAL BUSINESS FORUM

Ken Widelitz
Attorney at Law

A computer retailers' association you say. Who needs it? What would it do? Why discuss it here? First things first. Who need it most are the over three hundred foresighted persons who have waded, perhaps jumped, into the virtually uncharted waters of owning and operating a computer store.

The phenomenal growth in the number of computer stores has, not surprisingly, paralleled the growth in the microcomputer industry as a whole. Consider that the first computer store opened in July, 1975. The best estimates I've heard (they're not good enough to be called statistics) indicate that as of June 1, 1977, there were three hundred and six computer stores. That means that, on the average, one store has opened every 2.32 days during the past two years.

The proliferation of computer clubs is a testament to the fact that the microcomputer end user has found it necessary to associate with others for guidance, help and, at times, comfort. To make an analogy, the store owners need a national association in the same way that you need a club.

So why do you care about a store owners' association? Unless you own a store yourself, you probably don't. But remember, you can't buy a microcomputer, peripherals, magazines or service from a club. You need a computer store, and you don't want to drive two hundred and fifty miles to find one. Well, if the growth rate continues, you may just have to drive around the block. Of course, a national

association of computer store owners in and of itself will not be the most significant factor in realizing the dream of a computer store around the block. However, it can help existing stores stay healthy and give you better service, make it easier for new stores to come into being and help you avoid getting burned by a fly-by-night or otherwise incompetent operation.

Services to Store Owners

Let's examine some of the things a computer retailers' association could do. If you were thinking about opening a computer store, the first thing you should be asking is "How much money can I make from it?" Right now the universal answer is "Who knows?" Oh, sure, if you know a computer store owner, he might tell you how much he made in his first three months or, if he is an old-timer, the first year. That doesn't tell you very much. More important, you can't take that to the bank when you want financing for your store. Even if you've been in operation for a year, loan officers want to know how the industry is doing as a whole. They want to see industry ratios for profitability, sales, margins, inventory turnover, etc. I know from firsthand experience. My XYL (wife in ham lingo) is a loan officer. She is as conservative as any loan officer. She is also the chancellor of the exchequer in our house. Let me tell you, after the hassles I had to go through with her to get

funds for my Imsai, I wouldn't want to think about what it would take to get a loan from her.

Anyway, a national association could compile industry ratios. It would be done on a confidential basis so the store down the street wouldn't know exactly how you were doing, but you would know how you stacked up against the industry. That would help you tell if you were spending too much on advertising, or weren't turning your inventory over fast enough, etc.

The association would certainly draft a code of ethics and set standards of competency and service for members. Stores meeting this requirement would be certified and receive a plaque which would be prominently displayed. Potential customers would look for the certificate. Perhaps manufacturers and wholesalers would demand it.

The association would have a newsletter which might act as the "billboard" of the industry, keeping track of hot-selling products. The newsletter might also highlight industry developments, new marketing techniques or expense-saving tips.

It is possible that the national association could provide centralized warehousing for high-priced items. I am not talking about a buying consortium per se, but rather a limited inventory assistance operation. For example, an inventory of three Diablo printers is about all most stores can afford to carry. I have been told the lag time on new orders runs four to six months for such items. What if you, the customer, are fourth in line. You wait or the store owner loses the sale. If you are a business customer, the store owner might lose the sale of the whole system. If the store owner has access to a central warehouse, when he experiences an unusual number of orders in a given week or month, he could draw from the warehouse, save the sale and make de-

livery in a few days rather than many months. What's the cost? Virtually nothing! The store owner merely has his inventory investment in the warehouse rather than in the stockroom. Warehouse costs, labor and shipping could be met out of savings realized in quantity purchases by the association. In the realm of a pure buying consortium, it might be useful in the capital investment area, i.e., display racks and other store fixtures.

Perhaps you want to finance or lease a computer. Some stores have financing and lease plans available, but you pay a very high interest rate. A national association could possibly negotiate a package with a major financing institution and get more favorable terms because of the volume involved.

One thing a national association could do which no individual store or even a chain of franchises could afford to do is lobby. In the area of legislative advocacy, the interests of store owners are usually going to coincide with the interests of everyone involved in the industry. I'll be getting into the legislative problems facing the industry in a future Forum, but I'm sure many of you are currently familiar with the proposed Right to Privacy bill and its dampening effects on personal computing. Look at the Goldwater interview in the May/June *Personal Computing*. The Right to Privacy bill would affect the microcomputer industry before the industry has had a chance to make much impact on society at all. In the years to come, I'll bet we see legislation proposed which will be directly aimed at controlling personal computers in some way or another.

Computer store owners need liability, casualty, health, life and workman's compensation insurance. An association could make group rates available. It is also possible that an association could make a deal for

continued on page 18

BASIC FORUM

John Arnold/Dick Whipple

Several items are before the Forum this month. First we want to thank the readers of *Kilobaud* who have contributed to BASIC Forum in the last few months. We are making every effort to insert your material in our column. Also, a word to those of you who have not written to BASIC Forum. The original purpose of this column was to provide a means for users of BASIC to share ideas — both on an individual-to-individual basis and an individual-to-mass readership through *Kilobaud*.

There are countless books that instruct in the BASIC language. We want BASIC Forum to be more than that. It should provide a mechanism for sharing experiences and problems with BASIC. We do not want to see it serve strictly a one-way tutorial function. In an effort to stimulate some reader participation, we have included this month a problem to solve using BASIC — more about this later.

Tarbell Comments

Two letters arrived recently that we want to consider. The first comes from Don Tarbell of Tarbell Cassette fame. It seems that Don has been on the lookout for some revisions in BASIC. Let's have a look at his comments: "I have been keeping an eye on the BASIC Forum, and have decided it's time to put in my two cents' worth. I've been interested in the problem, because I'd like to program in a higher-level language, and think BASIC is nice, *except*:

1. You can't use alpha-

numeric labels, making the programs hard to read and debug.

2. Only the first two characters of variable names are usually used by the interpreter or compiler, which also makes it difficult to use meaningful names.

3. Often, there is no good way to save and load alphanumeric data, which is especially useful for business applications.

4. The lack of local and global variable names makes it difficult to use subroutines from a library.

There are other items, but most have already been mentioned in the Forum. It is possible to make an interpreter or compiler that corrects for the above problems, and yet will still run programs written for Mits and other common BASICs.

Enclosed is a request for quotes (RFQ) on an interpreter of this type. I've sent it out to several companies and individuals, with no positive responses.

I would also be interested in an interpreter with the same features, except without the high math of BASIC, such as the trig functions, logs, etc. This would be a good package for very small business systems. I am presently starting to write an interpreter for this language, but don't know if I'll have enough time to complete it, since I'm pretty busy.

I agree that a language is much better if it lends itself to programming in a more structured format, and I think that these additional features will allow that. Actually, the only tricky part of writing an interpreter for this language is retaining good editing features. Note that since the BASIC language is left essentially intact, the

"popular momentum" should act in its favor.

Please print the RFQ so that any of your readers who are interested can respond."

Tarbell Electronics
20620 S. Leapwood Ave.
Suite P
Carson CA 90746

Request For Quotes

Gentlemen:

I would like a quote from you, which would state the price and delivery time of an interpreter with the characteristics listed below:

1. The interpreter would run on an 8080 microprocessor-based system.

2. The language recognized by Mits Altair BASIC 8K 4.0 would be a subset of this language, and there would be no conflicts (within reason) with their advanced versions (12K, DISC).

3. All input/output would be performed through a monitor, which could be either separate or a part of the load module.

4. An ASSIGN statement would be added, which would assign I/O functions to I/O devices.

5. Alphanumeric labels would be allowed instead of line numbers, or line numbers could be used, or no labels could be used. This would require a small change in the manner in which the interpreter would recognize immediate execution commands as opposed to program text. I would also require slightly different editing facilities.

6. Variable and array names could be of any length up to 16 characters. Where there were conflicts with imbedded key words, the key word would have precedence. The intent would be to execute the statement so that Altair BASIC statements would be handled properly.

7. Allow the saving onto Tarbell Cassette of the BASIC program or any array (string or numeric), and the loading back in of

the program or array.

8. Provide a command to append new program text to the present program text from cassette.

9. Since there might be a label conflict or a variable name conflict after using the facility in #8 above, a BLOCK statement would be required to separate blocks that have independent variable names and labels.

10. So that BLOCKS could be used as subroutines, GOSUBS should be able to have dummy variables as arguments.

11. The interpreter should occupy no more than 16K bytes of memory, and preferably less than 12K bytes."

Our impression is that creation of such a language would be a rather ambitious project. Specifications 5 and 6 above would seem to offer the greatest difficulty. In fact, a BASIC compiler rather than a simple interpreter would probably be required. Although the language enhancements would be welcomed by experienced programmers, we doubt that the average user of BASIC would be much helped. Again we arrive at the problem mentioned by Richard Blumenfeld in the August issue — should BASIC necessarily range too far from its intended purpose as a language for beginning programmers?

Beginner's Hints

Another note comes from George Haller who you remember was the first contributor to BASIC Forum, and who, in fact, had the original idea for the column. George has another suggestion which we like. He wants to see a "Hints or Tips to Beginners" section in the BASIC Forum. He sends along two programming ideas to get things started (see Examples 1 and 2).

The semicolon is the key to the use of a FOR-NEXT loop to print multiple dashes. It suppresses the

continued on page 17

NEW PRODUCTS

Timesharing BASIC Available from Altair

Altair Timesharing BASIC for microcomputers is a unique and dynamic package with powerful capabilities that challenge a field dominated by larger, more costly computers.

Altair Timesharing BASIC and Altair Timesharing Disk BASIC are magnified versions of the powerful and efficient Altair Extended BASIC. Each version includes increased capabilities to accommodate as many as eight different programs running simultaneously and independently within the system.

Input and output are interrupt driven and fully buffered to provide virtually instantaneous keyboard response even when the system supports the maximum number of users. The output buffers empty more quickly than they are filled, thus it will appear the CPU is dedicated to each individual terminal.

Operating within a highly efficient round-robin system, the CPU suspends operation of a job currently being executed, stores the address of the next instruction and moves to the next job. Each job is served a hundred millisecond slice of its program.

Established as a Fixed Partition System, each job is confined to a unique area of memory. Users may then access only their individual jobs, not the system or other jobs. This protects jobs from alteration or destruction.

A variety of input devices can be linked to Altair Timesharing BASIC and Altair Timesharing Disk BASIC. This flexibility

permits the use of CRTs for high-speed data manipulations, Teletypes and hard copy terminals when hard copy output is required.

Altair Timesharing Disk BASIC provides rapid loading and program retrieval since all programs reside on a floppy disk. Read and modify passwords may be specified for program fixes to limit access by other users.

Altair Timesharing BASIC can be loaded from paper tape or audio cassette. Programs may be stored for later use on paper tape.

A single Altair 8800b loaded with either version of Timesharing BASIC can be utilized by several students performing independent operations. One student practices program development, another makes use of Timesharing BASIC's extensive diagnostics to debug a program while several other students calculate complicated equations. All program activity occurs simultaneously with

sharing System is a valuable visual tool to assist in the instruction of science, math and engineering classes and as an introduction to the various aspects of computer technology to solve real world problems.

Contact MITS, Inc., 2450 Alamo S.E., Albuquerque NM 87106.

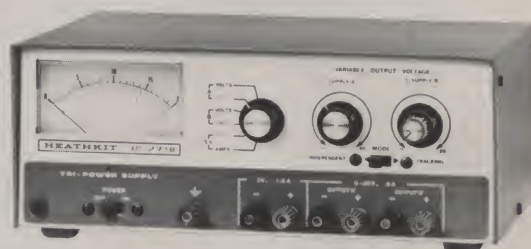
Low Cost X-Y Plotters

Sylvan Hills Lab announces the availability of 8080-based software to control their series of plotters. This enables the microcomputer to act as the controller for the plotter

Inc., 4926 Travis, Houston TX 77002.

Plotters are shipped completely assembled and tested, but require the purchaser to mount them on his drawing surface and do the interconnection between the control PC boards and his computer. Requires an 8-bit parallel I/O port and 5 and 24 volt power sources.

Applications include architectural, mechanical, and schematic drawing; PC board artwork; positioning of small objects; computer generated art; games; and many others. Sizes available are 11 x 17 (\$750), 17 x 22 (\$895) and 22 x 34 (\$1200). Sylvan Hills Lab, Inc., #1 Sylvanway, Box 239, Strafford MO 65757.



Heathkit Tri-Output Power Supply.



Software Plotter Control.

New Power Supply From Heath

Heath Company has released a new Tri-Output Experimenter's Power Supply. The IP-2718 has three floating outputs that can be connected in any combination for a wide variety of output voltage and current capability. A single, fixed 5 V dc at 1.5 A and two variable 0 to 20 V dc at 0.5 A outputs should prove adequate for most experimental applications.

All outputs are short-circuit proof with current limiting and can be operated independently, in series or in parallel. A switchable front panel meter monitors all outputs.

no discernable response delay.

Computer-oriented education need not be limited to programming classes. An Altair Time-

and requires about 2K of memory. The software format is such that it may be used in conjunction with application routines available from Micro-Visions

The IP-2718 is also available in a fully-assembled version, the SP-2718. They are mail-order priced at \$79.95 and \$140 respectively. Write Heath Company, Dept. 350-24, Benton Harbor MI 49022.

Custom Computer Front Panel

The Computer Mart of New Jersey announced a custom front panel for the SOL and Imsai at the Trenton computer festival.

The user sends in a drawing or an idea (which their artists work on) or simply a name, and they use standard lettering. A photographic negative of the total front panel is then made and inserted into the machine over a light background (white is most effective). The panel cost is \$15.

Advertising Department, Computer Mart of New Jersey, 501 Route 27, Iselin NJ 08830.

Computalker Announced

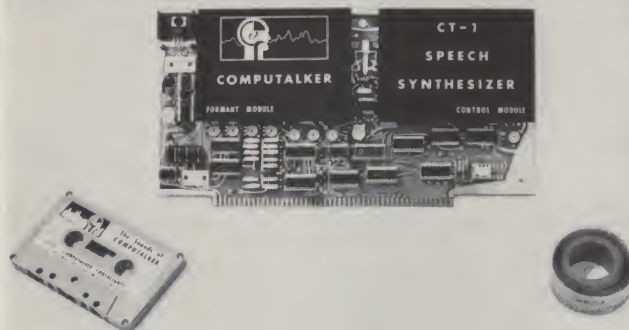
Computalker Consultants announces the Model CT-1 Speech Synthesizer, the first microcomputer plug-in speech synthesizer board capable of truly high quality speech output.

The Model CT-1 optimizes the trade-off between low data rate speech and directly digitized speech. Low data rate speech relies on canned definitions for the sound of each phoeme, which produces mechanical sounding speech. Digitized speech, while remaining faithful to the original sound, requires 10K to 20K bytes per second of storage and is inflexible to phonetic manipulation.

With the Computalker Model CT-1, the sounds are defined in real time under software control. Parameters which represent the phonetic structure of human speech are trans-

mitted to the CT-1 at a rate of 500 to 900 bytes per second, depending on the data compression techniques used. This allows the production of highly intelligible and quite natural sounding speech output. Voice characteristics and language or dialect variations are retained in the output.

The Computalker Model CT-1 can also be operated in a low data rate mode using phoneme definitions contained in the CSRI Synthesis-by-Rule software package. The Computalker speech synthesis system, used in this way, has the advantage that the software driver can easily be modified to keep the naturalness and intelligibility of the



Speech Synthesizer Board.

speech output up to date with the constantly evolving state of the art of rule governed speech.

The Model CT-1 is a factory assembled and tested board, 5¼" x 10", which occupies a single slot on the Hobbyist Standard Altair bus. It requires a block of 16 output locations, one byte (8 bits) each, relocatable to any hex boundary via an on-board selector switch. Power requirements are +8 V unreg. (or +5 V reg.) at 170 mA typ., 250 mA max, and ±16 V unreg. (or ±12 V reg.) at 85 mA typ.

The CT-1 Speech Synthesizer sells for \$395 and the CSRI Synthesis-by-Rule software package is \$35 from Computalker Consultants, P.O. Box 1951, Santa Monica CA 90406.

Byte Shop Mail-Order Catalog

The Byte Shopper is a new catalog designed to present the world of personal computing to the public. The catalog features complete descriptions of microcomputer systems that can meet the needs of the hobbyist or businessman.

It is also an introductory text to personal computing, providing simple explanations of computer buzzwords and graphic visualizations of how microcomputers work and where they can be useful.

The Byte Shopper is informative reading with superb graphics on 11" x

to an overall computing system. Several typical systems are pictured and discussed in detail. Over 50 manufacturers are represented with pictures of nearly all products discussed, providing an effective access to the broad range of personal computers, peripherals, accessories and introductory texts. A price sheet is included. From Byte Shops, PO Box 28106, Tempe AZ 85282.

New Disk Operating System OS-65D

OS-65D is a complete operating system for all disk-based Ohio Scientific computer systems. The OS-65D includes DOS, 8K BASIC, Assembler, Editor, Extended Debugger, and a Disassembler.

By use of overlays, the complete system never occupies more than 12K of memory, yielding high performance on small systems (16 to 20K total memory).

All modules of the system utilize a sophisticated I/O distribution system where any of seven input devices and any combination of eight output devices can be serviced. Standard I/O supported by



Byte Shopper Catalog.

14" pages and a glossary of common terms for easy reference. The guide integrates manufacturer's specs with a down to earth discussion of how to use each product and how it relates

OS-65D includes a serial port, video display, serial and parallel keyboards, cassette I/O, disk I/O, and a parallel line printer port.

OS-65D has extremely powerful disk file capa-

bilities. The system supports single and dual drives with a variable sector length DOS. OS-65D allows sequential, random access, and indexed sequential disk files in conjunction with BASIC programs as well as program linkage. N number of disk files can be open simultaneously with mixed sector lengths.

OS-65D is now being supplied as standard on all disk-based Ohio Scientific systems and is available to existing owners at modest cost. Ohio Scientific, Hiram OH 44234.

Altair Minidisk from Mits

The miniaturization of mass storage is just one of the exciting features of the new Altair Minidisk System. Designed to work with the Altair microcomputers, the Minidisk has a storage capacity of over 71K bytes per diskette with an access time of less than three seconds.

Altair Minidisk BASIC resides in the lower 20K of Altair 8800b memory (lower 12K in the Altair 680b) and provides the disk utilization routines. Minidisk BASIC includes the standard functions of 8K BASIC plus many extra file maintenance procedures that significantly increase programming power. The software driver for the Minidisk Read/Write functions is based on the hard sectoring format, which simplifies system configuration.

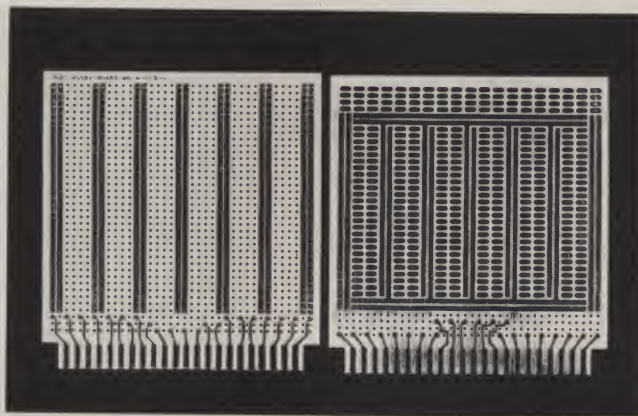
The Altair 8800b computer interacts with the Minidisk Drive through two Minidisk Controller Cards that plug into the Altair bus. The Altair 680b uses a single board controller. All control, status and data I/O signals are handled through I/O ports dedicated to the Minidisk Controller. To insure maximum life of the drive motor, a timer in the Controller turns the system off if the Minidisk is not accessed for five seconds.

The Minidisk Drive Case contains a disk drive, power supply, line buffers and

addressing circuitry. The drive address is switch selectable. The selected address is displayed on the front panel for easy identification. Write protect is also a standard feature on the drive. MITS, Inc., 2450 Alamo S.E., Albuquerque NM 87106.

or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual buses running the full length of



OK's Universal PC Board.

Universal PC Board

Model H-PCB-1 is the first in a new series of top quality PC boards for the serious amateur. The 4 x 4.5 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. In addition, the board has a 22/22 two-sided edge connector.

The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Components may be soldered directly to the board,

the board for complete wiring flexibility. Available for \$4.99 from O.K. Machine and Tool Corp., 3455 Conner Street, Bronx NY 10475.

Vector 1+

The Vector 1+, ideal for business applications, has provisions to incorporate a Shugart mini-floppy or an exact equivalent. Starting at \$389 you get an 18-slot, fully shielded motherboard, Altair bus, 6 connectors, a power supply 18 A, 8 V; 2.5A±16V. A whisper fan

and a power supply card to modify the Shugart drive are included.

An 8080-based CPU board with 8-level vectored interrupts, a real time clock, and a board with 1K of RAM and room for 2K of PROM designed for an I/O board of your choice is also available.

In addition, the unit requires an I/O board and a terminal or video board, keyboard and a monitor. Vector Graphic Inc., 790 Hampshire Road A-B, Westlake Village CA 91361.

A Computer That Thinks in BASIC

Ohio Scientific's new Model 500 CPU board can be used as a standalone computer or as the CPU in a larger system. The board accepts 8K of ROM, 4K of RAM, 750 bytes of PROM, and ACIA based serial port, a 6502 processor, and full buffering for expansion.

The Model 500 is available completely assembled with 8K BASIC in ROM for \$298. By simply adding a terminal and power supply, the user has a complete system which will accept up to 200 lines of BASIC program without expansion.

The Model 500 is software and hardware compatible with Ohio Scientific's 400 kits and Challenger products, thus allowing expansion to a large system.

The board is available enclosed with power supply as the Model 500-1 and is available in an eight slot Challenger case as the Model 500-8. Ohio Scientific, Hiram OH 44234.

Vocal Input to Computer

A new system compatible with all Altair bus computers to provide voice input and control, replacing keyboards in many instances, has been announced by Heuristics, a Los Altos,

continued on page 47



Vector 1+ Accepts Mini-Floppy.

BOOKS BOOKS BOOKS

Microprocessor Basics
 Edited by Michael S. Elphick
 Hayden Book Company
 Rochelle Park NJ
 07662, \$9.95

My first question when I sat down to write this review was whether *Microprocessor Basics* was even aimed at the hobbyist market. The title would seem to imply that it is, but since the book is a collection of reprints from *Electronic Design Magazine* I felt the question deserved close consideration. My conclusion is that the book is not for everyone (but then, what book is?). It should be of great interest to those hobbyists who home brew their systems and those involved in building microprocessor-based controllers. Since the articles are reprints from *Electronic Design* most (if not all) were written for design engineers and, therefore, should be of interest to hobbyist designers.

The book is divided into nine chapters, with six of them devoted to particular microprocessors and design/interface considerations. The 8080 and 6800 are running neck and neck — both have five articles in their respective chapters. The lead article for both chapters is an overview of the 8080 and 6800 written by engineering managers from Intel and Motorola. The 8080 section also contained such articles as "Boosting Bit-Manipulation Capability," "Speeding Microprocessor Responses," "Running Microprocessor Software," and "Designing a

Microprocessor Analyzer."

The 6800 chapter contains selections such as "Assembly Language for Microprocessors," "A Universal Test System," "Microprocessor-Based Data Acquisition," and "Controlling Programmable Instruments." From those two lists you can see that substantial portions of the two chapters are devoted to industrial applications.

The first section, entitled "Getting Started with Microprocessors," contains five introductory articles, including "Addressing Modes for Microprocessors" by Dr. Lance Leventhal, who has written several articles for *Kilobaud*. Once again, these articles are directed toward the industrial/commercial design engineer. In a nutshell, the section deals with the hardware and software available to the designer (evaluation kits, development systems, and assemblers).

Other microprocessors covered include the Fairchild F8, the National Semiconductor PACE, and the National Semiconductor IMP-16 chip set. The final chapter is a catch-all entitled "Some Recent Microprocessors," and covers the Signetics 2650, RCA Cosmac 1802, and Intersil 6100 micros.

Surprisingly, nothing was included on the MOS Technology KIM-1 board since it is one of the most popular evaluation/controller boards around (there have been several thousand sold). Another shortcoming is the absence of any articles on the Zilog Z-80.

I think the book will be a worthwhile addition to my library of references. If it had an index, it would be

even more valuable; but since most chapters deal with specific microprocessors perhaps that isn't a major point.

Russell Lauffer
 Los Angeles CA

SC/MP Microprocessor Applications Handbook
 National Semiconductor Corporation
 2900 Semiconductor Drive
 Santa Clara CA 95051
 159 pages,
 October 1976

After an introduction and 15-page review of the SC/MP, this handbook describes eight applications in detail — 14 if you include variations. The applications include: electronic combination locks, handling analog-to-digital converters, performing a D/A conversion using the SC/MP and a comparator and an A/D converter, keyboard scanners, a display generator for the Burroughs Self-Scan, a cassette recorder interface to the SC/MP (40 bytes/second), and a Seiko printer interface (handling 13 columns of numerica data and 3 columns of special symbols).

The 14 applications are given in great detail, including the programs.

There are 5 appendices: Clock Considerations for SC/MP, Address Assignments and Decoding Methods, SC/MP Interrupt System, Math Routines, Implementing Program Delays For SC/MP.

The book is well-illustrated (62) with block diagrams, circuit diagrams, flowcharts and six tables.

It is assumed that the reader is familiar with three other publications: 1. The 33-page *User's Manual*, which is very clear, assumes only a basic knowledge of computers and provides one applications example. 2. The 61-page *Technical Description*, the same comments apply. 3. The 103-page *Programming and Assembler Manual*, which is very clear and assumes

almost no prior knowledge.

Although this book is not light reading, I heartily recommend it to anyone who has a Scamp. Incidentally, the book is written for the first version of the SC/MP, but would also be useful to someone who has the second version. The first version uses PMOS technology and requires two power supply voltages; the second version is faster, using NMOS technology, and requires only one. The architecture and instruction sets are identical.

Doug Penrod
 Santa Barbara CA

Basic BASIC
 An Introduction to Computer Programming in BASIC Language
 James S. Coan
 Hayden Book Co.,
 1970

This book appears intended for the person who wants to seriously study computer programming in BASIC and at the same time learn some interesting mathematical concepts. It is written in the form of a textbook and could, in fact, be used for that purpose in a computer programming course. Each chapter contains numerous programming examples, a summary, and a set of problems to work out. The problem sets contain both easy and challenging programs with answers to the even-numbered exercises.

Enough BASIC is presented in the first few pages to allow the reader to develop his first program. Of course, access to a computer running BASIC is important. Only in this way will it be possible to test your programs for correctness. Program planning is emphasized with the use of flowcharting. By the end of the second chapter, the reader has been introduced to the PRINT, READ-DATA, LET, REM, and IF statements.

Chapter three introduces the concept of looping and

continued on page 18

LETTERS

Single Voltage A-to-D

I read with interest the article "Only Five Senses" (March '77) by Mark Borgerson. I think his is the least expensive and the most effective analog to digital conversion technique I've ever seen yet. However, I have always been reluctant to use any device that requires a dual-polarity power supply. That was one of the major reasons why I chose the M6800 as my processor.

I don't know much about operational amplifiers but as I see it from the circuit pictured in the article, Mark uses the 741 op amp as an integrator whose output voltage is, as I recall from my school days, always negatively proportional to the integral of the input voltage (or $V_0 = -1/RC \int V_{in} dt$). I can see why he uses negative input voltage because a negatively going step at the input from zero to -4.7 volts will produce a positively going ramp from zero to +4.7 volts at the output.

I have a question: Wouldn't it be possible to use one of the newer quad op amp integrated circuits (such as 3900 or 324) which can be operated from a single-polarity power supply, connect the inverting (or minus) input of one of the op amps to +5 V (through R_1 and R_2), and use one of the three remaining op amps as an inverter? And, since most A/D applications require only one voltage channel, what about connecting one more op amp as a comparator? Thus, we would reduce the IC package count to one, dispose of the zener diode, and get by with a single power supply. Any comments?

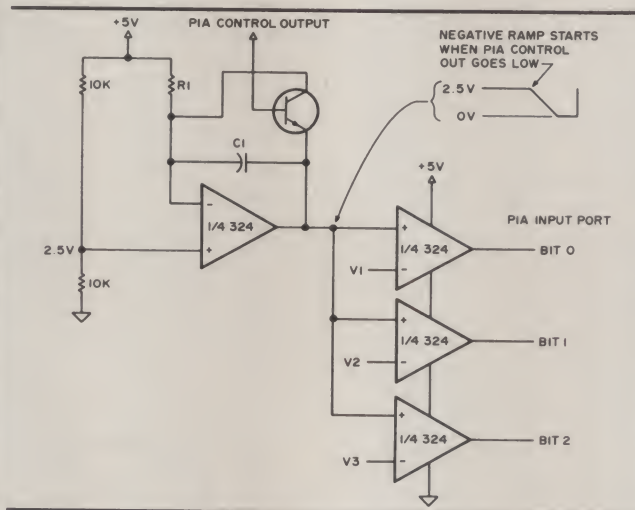
Gustav R. Jindra
San Francisco CA

Reply From Mark Borgerson

Dear John,

I read Gustav's letter with some interest and in the hope that this letter can make your next deadline. I'm sending you a quick (but hopefully reasonable and accurate) response. I won't have the time to try out any of my proposals on the breadboard for several weeks, but I hope one of

a 5 volt supply you can only generate a linear ramp up to about 3.8 volts. Limiting the ramp to a 2.5 volt swing should provide a good input range and a nice round number to work with in the computer. The other problem with the single-supply approach is the one Gustav has noted — the ramp will start at a positive value and decrease in a linear fashion. This is no problem to the computer — you just monitor the input bits to see when the ramp becomes less than the input. The comparator output will change states at this point. The problem you face here is setting the positive voltage level at which the ramp starts. To do this you need two resistors across the 5



your other readers will get a chance to try them out.

In answer to Gustav's question about the possibility of using a single power supply and a type 324 op amp all I can say is to try it and see if you can make it work! I've included a tentative design on a separate sheet which should work — or at least come close. Even the professional circuit designers like to prototype a circuit before making any kind of a guarantee. The one major problem I see in using a single-supply op amp with a 5 volt supply is that these amplifiers don't work too well closer than about 1.2 volts below the positive supply. This means that for

volt supply. Thus the voltage at the output of the ramp generator is not only set by the value of the resistor at its current input, but also by the ratio of the two resistors at the non-inverting input. Perhaps this won't even be a problem. If you get a good answer to this question let me know!

By the way, the reason I used a 741 op amp and a bi-polar supply is that both were available ... and I have used the 741 many times with good results. My computer (as do most systems with 20 mA current loop TTY outputs) already had a ± 12 V supply.

Mark J. Borgerson
Corvallis OR

Imsai Controlled Church Service?

Well have we finally reached the ultimate in computerization? It appeared that way with an Imsai 8080 sitting on top of the pulpit near the Altar in front of our church.

A group of us at the church I belong to put on a play the Thursday before Easter. The play was titled "The Verdict" which depicted a modern courtroom trial of Judas. We needed a computer for a prop ... so why not the company Imsai 8080? I had just completed the "Slow Stepping Debugger" change to the Imsai that appeared in the April issue of *Kilobaud*. It was just the thing I needed to get those impressive slow flashing lights for the "courtroom computer."

After the play I took a picture of the Imsai, but it blurred ... perhaps there is a power greater than the Imsai 8080.

Bud Cronenberger
Buffalo NY

More Elementary Articles!

Each issue of *Kilobaud* is better than the previous issues — you are setting yourself an impossible task!! Perhaps you have found an application for the Signetics 25120 (9046 x N, RAWOM).

I haven't finished reading issue no. 4 yet but the sorting routines of Andrew J. Rerko are exactly the kind of articles I need! Such routines may be old hat to the experts, but the rest of us still require leading by the hand through the simple routines.

Any chance for one of your authors to write up an appraisal of the HAL MCEM 8080 system?

How about a "Child's Guide" for how to read a waveform diagram? Don Lancaster's articles on clocked logic will probably be of more value to me — when I can read the truth table/decoding states/wave-

continued on page 14

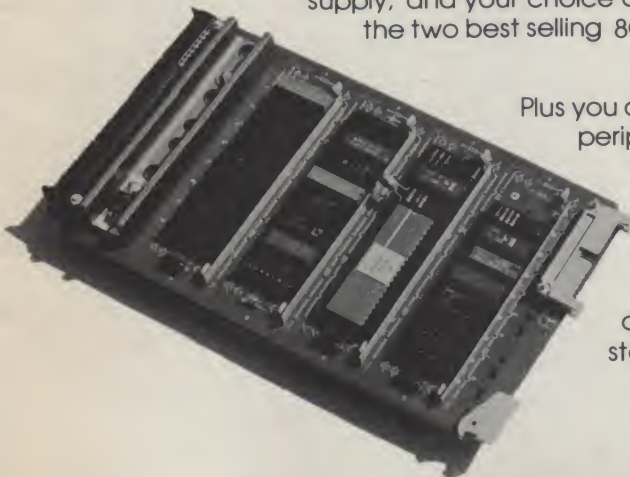
WAVE MATE



(shown with Jupiter disk)

LOOKING BETTER ALL THE TIME

But we offer you more than just a beautiful new cabinet. The Wave Mate Jupiter IIA and Jupiter IIIA systems come to you fully assembled and tested, with backplane, plug-in ferro-resonant power supply, and your choice of either 6800 or Z80 CPU modules. All for less than the price of the two best selling 8080 systems!



Plus you can choose from the fastest growing selection of memories and peripherals available from any manufacturer.

Our 2KB EPROM/4KB RAM/Serial interface module can start you on your way to high-quality, full capability, low cost personal computing. As your needs for computing power grow, add our video modules, our audio cassette interface, or even a high-speed matrix printer or floppy disk - all built with the same quality and dependability the Wave Mate name has come to stand for.

All Wave Mate products meet the highest quality industrial standards, with rugged construction unmatched by anyone. If you are serious about personal computing, call **Wave Mate**.

Send information on: ☐ Jupiter IIA
☐ Jupiter IIIA

NAME _____

ADDRESS _____

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WAVE MATE 1015 West 190th Street, Gardena, California 90248 Telephone (213) 329-8941
Dept. 25

W5

forms.

Jack Inman's "Number Rounding Program" is more my level.

Would it be convenient for you to put your "Corrections" section on the same page of each issue?? I'd like to turn to that section when I get a new issue, and mark up my previous issues before I get settled down to read the latest issue.

As you may detect, much of the scoop in *Kilobaud* is over my head; but the generous supply of more elementary articles is helping me to learn. As I learn, I can go back and re-read previous issues and understand them the second (or third) time around. Thus, *Kilobaud* back issues serve as an on-going text for me.

Percy Buzza
Nova Scotia

Right on Target

Having already written once to say how much I appreciate your magazine, I will say no more about that except to add that the "Kilobaud Classroom" is right on target. I plan to start studying just as soon as I can get a Superstrip and some components.

```
25 FOR I = 1 TO 11: A(I) = 0: B(I) = 0: NEXT I
30 READ I, M, N
35 IF I = -99 THEN GOTO 45
40 A(I) = A(I)+M: B(I) = B(I)+N: GOTO 30
```

Example 1.

I do have a complaint about the "Features" section in the May issue. The review of EDIT on page 4 refers to a "Table 1"; this table appears on page 5 with a caption that really belongs on page 4 with the Table 1 which is referred to at the end of the Dutronics review, on page 21. Then the BASIC Forum refers on page 17 to two figures that do not appear until page 23. You could at least put page numbers in brackets after the references to these figures so that we can find

them without a lot of searching.

Finally, I would like to comment on some of the programs in the May issue. Lee Wilkinson's sales program looks like a good practical application for a small business. His program modification chart is an especially good feature. The program itself could be simplified slightly by replacing lines 50 through 60 with a simple GOSUB; deleting the RETURNS from lines 110 through 160 and adding a single RETURN after line 130. It could also be modified to add up daily or weekly sales figures (see Example 1).

The format of the DATA statements is: TYPE CODE, \$ SALES, NO. SALES. A type code of -99 is used to signal the end of this group of data.

David Stanfield's approach to tic-tac-toe has the programmer doing a lot of work that the computer could do. We could number all of the rows, columns, and diagonals and set up two tables: one giving the numbers of the squares on each line and the other telling which lines each square is on. To find a win in one move, we look for a square on a line on which we already hold two squares. To find a win in

two moves, we look for a square on a line on which we hold one square and the other square is free. If we can find a square on two such lines, we can set up a fork. We can make the computer's moves unpredictable by shuffling a list of free squares and using this list to determine the sequence in which we evaluate possible moves. This approach has the advantage that it can easily be extended to three-dimensional tic-tac-toe. With some additional

programming and a lot of imagination, we could even try a four-dimensional tic-tac-toe.

Randy Foster
Sandusky OH

KB Classroom Limiting Resistors

Thanks to George Young for writing what is, to me, the most timely, understandable, and just plain fun series of articles I've encountered so far in *Kilobaud* or any magazine. KB Classroom is precisely what I need; it is basic, ongoing (for a long time, I hope), and well-written. I especially liked that first project whose main purpose was simply to work. Great for "all-thumbs" like me.

I've been following your articles faithfully every month and always wish they were longer. How about more experiments or schematics to play with?

I've been supplementing KB Classroom with Don Lancaster's *TTL Cookbook* and with *Bug Book I*. I've built a breadboard console from *Radio Electronics* (Feb-Mar 1975), and found among other problems (it's my first home-built project) that the LED register inputs are so sensitive that they turn on with any voltage or contact — even while sitting in a (wooden) chair, a simple touch of my finger will do it. So now I'm taking it apart and starting over using 7404s.

Now for what all this leads up to. In KB Classroom #1 (KB #5, p. 121), why are resistors necessary, but in Fig. 7(a) they apparently aren't? Do some ICs have their own current limiting? If so, which ones, and how can I tell? I used a 7404 in the Superstrip and it seemed to work allright — no smoke anyway. Will each 7404 inverter drive one LED (six per package) without resistors? Continuously?

I hope you can help me with this problem. Thank you again for a fine series. Keep it up!

Gordon Furman
Santa Barbara CA 93109

George sometimes forgets to include a current limiting resistor with his LED circuits and I try to catch the omission whenever I can. In an experiment (i.e., short term) it's not too bad to leave it out, but we certainly don't want to build permanent circuits without them. The LED might draw as much as 30 mA without the resistor and as little as 5 mA with it. Needless to say, this means the IC will be working a lot less ... and live a lot longer. — John.

FORTRAN! FORTRAN!

I cannot believe my eyes that "8080 FORTRAN IV Compiler" by Microsoft didn't even make the index. It got buried in News of the Industry. Really!! If you were around in 1903, would you also have bumped out Wilbur Wright's first flight as so many newspapers did to carry a man bites dog story?

This is the most significant item in this issue.

Lauson F. Pierce
Columbus OH 43219

Lauson, I don't know whether you got so excited about that announcement because we made a typo error and said it was selling for \$50 (instead of \$500) or because you're an old dyed-in-the-wool FORTRAN man. Either way, it'll be very interesting to see just what impact 8080 FORTRAN has made on the hobbyist, industrial and small business communities three years from now. I don't think it will be very great, but if I'm wrong I'll happily eat my words. — John.

Only One Restored Caruso

Thanks so much for the encouragement on the Digital Audio articles. I've received several interesting letters and comments on the series, and soon I hope I can produce an update installment.

A couple of corrections managed to slip past in the last article (Digital Audio III, the one on signal processing) concerning the work of Dr. Thomas G. Stockham, Jr. R.C.A. has released *one* LP (not "a series of lp's") featuring restorations of recordings of Enrico Caruso by means of digital signal processing. It's called *Caruso, A Legendary Performer* (R.C.A. Red Seal #CRM-1-1749).

I also mentioned that a process had been developed that could remove the *voice* from the orchestral background. This is not exactly so. Dr. Stockham combined his techniques with those of colleague Neil J. Miller to reproduce the voice with the orchestral accompaniment removed. This was accomplished by the use of an Openheim-style, homomorphic vocoder, developed by Miller, which effectively synthesized Caruso's voice based on information processed from the original acoustic recordings. That should excite you computer music buffs: Caruso (and computer) singing again after 60 years!

Tom Scott
Mill Valley CA 94941

TV Mods — Another View

I read Grant Runyan's article "The Great TV to CRT Monitor Conversion" in the July issue, and there are several points I would like to bring to your readers' attention. One is that the 10 pF capacitor across the spark gap SG251 should be rated as capable of withstanding at least 200 volts. Another is that Hitachi has changed the sets so that the more recent ones do not draw current when they are turned off.

Grant is quite correct in saying that the Pickles & Trout kit does not produce materially better results *on his system*. He is using an extensively modified TWT 1 which has 32 character lines and a video signal of 5 volts. The advantage of large bandwidth becomes notice-

able with lines of more than 48 characters. Our kit also provides dc restoration, while Grant's circuit does not. The advantage is not noticed until one has a video generator which can do graphics or display either white characters on black background or black on white. In this case the average level of the video signal changes drastically, and without dc restoration the brightness of the display will change and the set may even be incapable of syncing properly.

We have received orders from several people who thought we produced a kit version of Grant's circuit. We do not — the only TV modification kit we produce is the TVM-04, which uses a three-transistor circuit to obtain the performance we consider necessary to satisfy our customers.

Dana Trout
Pickles & Trout
PO Box 2270
Goleta CA 93018

Wrong IC

A bug. Fig. 3 in Michael Smith's "Build Your Own Interface" should be using a 74LS86 Exclusive OR. The board select combination of 74LS08s and a 74LS20 will not work. Trace a signal through. If any switch is closed (to represent a 0, the output of that '08 will be forced low irrespective of the other address input to that '08. That low, in turn, will force the output of the '20 high, and the board will be forced into a nonselected condition. But with an '86 in place of the '08, the circuit will properly compare the high order bits of the address with the switch and give with a boardselect when the address and the switch match.

Or looking at the XOR another way, it can be used as a logic controlled inverter giving a simple switch selected Axx-H or Axx-L for feeding to a '20 for address select.

I have noted that commercial interface boards prevent a board select until

certain timing conditions are met from various control lines and then latch the board select in order to hold it until the operation is complete. This may be due to the fact that while addresses are changing a match may be obtained for only a few nanoseconds (maybe tens or hundreds with a MOS CPU) which would cause false board selects and perhaps system bugs when the board responds. My Data General Nova uses all TTL logic in the CPU, but the addresses are not good for about 80 nanoseconds after ADDRESS ENABLE goes true. Gotta make sure the addresses are good before the select compare is performed. Otherwise there is a good chance for initiation of a board action or response on transient garbage. As Mr. Smith says, there are several ways to generate the board select. Fig. 3 will only work for addresses beginning with F16 or 178.

Dr. Gerald N. Johnson, P.E.
Ames IA

In reply to Dr. Johnson's letter, it is indeed correct that the 74LS08 will not work as shown in Fig. 3. This was a mistake on my part which, unfortunately, was not noticed until the article was already in print. Dr. Johnson is correct in noting that this should have been a 74LS86. Most of my own designs (as well as many commercial designs) use packaged comparators for this function, such as DM8136, etc.

As for the false board selects, there is no problem with Fig. 3 as shown. Keep in mind that the CHIPSEL signals, which are a function of BOARDSEL, are fed only to the chip select pins on the memories. In static memories (such as the 2102 types) this in itself causes no detrimental action. The gating signals (WRITE-L and READ-L) must be active in order to cause memory writing or data bus (DI bus) entry respectively. Note that WRITE-L is gated by MWRT-H from the bus and that READ-L is gated by SMEMR-H AND PDBIN-H from the bus. These gating

signals are derived from the 8080A control signals, and by referring to an Intel (or any other manufacturer's) data sheet it will be seen that DBIN and WRT never change when the address lines are unstable. The remaining use of the BOARDSEL-L signal is to enable the changing of the state of the protect flip-flop.

The protect and unprotect functions (from the front panel) are enabled only when the Altair is halted, in which case the address line will be stable (set to the examine address with the CPU "hung-up" in M1 and T2).

A point to keep in mind is that each computer system has bus timing requirements (be it mini, micro, or otherwise) which must be adhered to in order to assure glitch-free operation.

The logic shown in Fig. 3 (with the 74LS08 replaced by a 74LS86) meets all timing requirements for an 8080 being used with static memories, and in fact will work quite well.

Michael L. Smith
St. Louis MO

Robots?

I finally got caught up, just started reading KB 6. Concerning Mr. Prudhomme's nice article on the multiplexed scope adapter, shouldn't the designer of the circuit, C. S. Pepper, be given mention for his design (photocopy enclosed)?

Tom Scott's review on "Build your own Robot" was enough to make me order the book. I don't know how many other machine-happy people there are out there, but this book may be just the impetus I need to build something I've been thinking about (and even making mental designs for) for 20 years. As an aside, Tom mentions an article (of which I would appreciate a copy if anyone can accommodate me) by one Robert Rossum. For the non-SciFi people a point

continued on page 20

AROUND THE INDUSTRY

John Craig

One Giant Step For Heath

Now we're going to find out just how many of those hobbyists sitting around in a "wait-and-see" mode have

uct! Couple that fact with the apparent failure of their simple analog computer in the late '50s, and one can't help but wish them success. After all, if this effort flops, you won't even be able to safely say the word "com-



Heath's original entry into the field ... their analog computer from the '50s.

been waiting for Heath. How many do you think it will be? You better believe Heath is thinking in large quantities! Lou Frenzel, Director of Computer Products, said that he personally feels the market will grow to over 300,000 in the next few years. After several million PETs, Texas Instruments, and Realistic home computers have been sold, it's quite conceivable that the hobbyist ranks will swell to that number. Needless to say, Heath is planning on getting their share of that chunk ... and with what they have to offer there are plenty of reasons why they should.

The engineering effort which Heath put into the development of their computer systems is the largest the company has ever undertaken for any prod-

puter" around Heath for the next hundred years!

Everybody and his brother has been speculating for the last two years as to what processor Heath would wind up using. I, for one, never would have thought they would go with three different chips! It does look like they have all their bases covered though. (Although there is one I'm not too sure about.) The "bottom of the line" is the H-8, an 8080-based machine, which will sell for \$375. Their Cadillac is the H-11, which is based around Digital Equipment Corporation's LSI-11. This little powerhouse will be selling for \$1295 (gulp!). That's the one I'm not too sure about ... but, we'll see. (By the way, the recommended terminal for the H-11 is the DECwriter II, which sells for around



The 8080-based H-8.



Heath's H-9 Video Terminal.

\$1900.)

Some of the peripherals they have available now (others are in the works) include: a video terminal (the H-9) which has an 80 character by 12 line format, optional format selection, cursor control, batch transmit and plot mode. Three interfaces are available: 20 mA current loop, RS-232 and TTL. And ... how about selectable baud rates from 110 to 9600? It will be selling for \$530. I loved the smooth feel of the keyboard and everything about the unit except that it doesn't offer lower case characters.

Now for the H-8 ...

It has the feel and look of quality I would expect from Heath. The front panel consists of seven-segment displays for octal readout of data and addresses with an octal keypad used for entering data. The Heath engineers definitely took the right approach by using a keyboard for data entry instead of a row of switches. When you stop and consider the ease of entering data via the former method, compared to the latter, it's really the only one which



The LSI-11 in a new cabinet . . . the H-11.

makes sense. Some of the "feel of quality" I experienced was, I'm sure, a result of the audio response provided by the computer's monitor program whenever a key is depressed. The engineers had some rather strong feelings regarding their choice of octal over hexadecimal. They didn't even want to acknowledge the fact there was such a thing as hexadecimal! No big thing, though. The 8080 instruction set lends itself more naturally to octal than to hex anyway. The ideal accessory for an H-8 owner (or any other "octal lover") is the 8080 Octal Code Card from Tychon, Inc., PO Box 242, Blacksburg VA 24060 (\$2.95 postpaid). I use the hex version of this handy slide-rule card for my Imsai . . . and wouldn't be without it!

The H-8 doesn't come with any memory for that \$375 price tag. Additional 4K increments of static memory (all their expansion memory is static) sells for \$140. A serial I/O and cassette interface board sells

for \$110 and their parallel interface board goes for \$150.

Get ready for *Benton Harbor BASIC!* Charles Gilmore, Manager of Design Engineering, pointed out that they had run Tom Rugg's and Phil Feldman's benchmark programs (*Kilobaud*, Issue #6, "BASIC Timing Comparisons") on their BASIC and were quite pleased with the results. I'm hoping we can get those results and include them in an update of the article Tom and Phil are currently putting together. Along with BH BASIC they're also offering an extended version, a text editor, an assembler and a debug program. The only software for which source listings will be provided is PAM-8, the front panel monitor program (which is in PROM).

I honestly don't know where the H-11 (LSI-11) is going to go. DEC certainly hasn't sold very many of them to the hobbyist community . . . but perhaps Heath has a better feel for



Finally, an affordable punch . . . with a reader thrown in.

that end of the market than I do. My biggest problem is that I can't think of that many applications (outside of "larger" small business systems) which would actually dictate the use of an LSI-11 over an 8080-based machine. An interesting "by-product" of the H-11 (since the LSI-11 is somewhat "paper tape oriented") is the first paper tape reader/punch for the hobbyist community. It will be selling for \$350.

Heath's third processor is going to be a 6800-based trainer unit (Model ET-3400). They have plans to develop extensive home-study courses around it . . . which is something a lot of people have been looking for. The unit looks like it

will be a lot of fun. Word will be forthcoming on availability and what it will cost. (Oops, what's this? I just noticed the keypad on that unit. Looks like someone at Heath believes in hex after all!)

The training program that Heath is putting together for the people in their 47 centers around the country is a tremendous effort and I'm sure they'll find it very helpful if those folks can speak computerese like the rest of us.

As I said in the beginning . . . it's going to be interesting to see just how many people have been waiting for Heath. I'm glad they finally arrived on the scene. ■

THE BASIC FORUM

from page 7

carriage return and line feed that normally accompanies the end of a PRINT statement. Varying results may be obtained using different

BASIC interpreters. The semicolon normally produces a single space when separating items in a PRINT list. At the end of a line, the presence or absence of this space depends on the interpreter used. In some cases the dashes will appear with spaces in between. At least one interpreter we know of produces two spaces between dashes.

Some interpreters provide a statement to produce multiple character output. These are very convenient when printing headers and doing graphics.

Use of the INT of the LOG of a number will columnize decimal figures without the special formatting features of the PRINT USING statement. A sample program illustrates

this procedure (see Example 2).

The key to this trick lies in the use of the base 10 logarithm of the number. For values greater than 1, the whole number part of the base 10 logarithm gives the number of digits to the left of the decimal less one. Thus, in line 40, the number 1.23 produces a full TAB to position 6 [INT

Instead of
PRINT "-----"
to produce a large number of dashes — say 72 — you can use
FOR I=1 TO 72:PRINT " ";NEXT I

Example 1.

```

5 K1=LOG(10)
10 READ A0
20 IF A0 < 0 THEN STOP
25 REM LOG(X)BASE 10 = LOG(X)BASE E/LOG(10)BASE E
30 IF LOG(A0)/K1 < 0 THEN 60
40 PRINT TAB(6-INT(LOG(A0)/K1));A0
50 GOTO 10
60 PRINT TAB(7);A0
70 GOTO 10
80 DATA .01,.12,1.23,12.34,123.45,1234.56
90 DATA -1

      RUN (CR)
      .01
      .12
      1.23
      12.34
      123.45
      1234.56
      STOP AT 20

```

Example 2.

$(\log_{10}(1.23)) = 0$ and $6-0 = 6$ while 12.34 TABS only to position 5 [$\text{INT}(\log_{10}(12.34)) = 1$ and $6-1 = 5$]. In the latter case an extra position is created, causing the decimal points to line up. In line 20, all positive fractions are permitted a full TAB to position 7. A simple PRINT A0 substituted would have produced the following output:

```

.01
.12
1.23
12.34
123.45
1234.56

```

These left justified figures would not be appropriate for columnizing monetary values. The first method is not totally satisfactory for money either. Consider what happens when whole number values are READ and PRINTed:

```

.01
.1
1
10
100
1000

```

What happened to the decimal and zero cents?

Programming Problem

As mentioned at the beginning we have a little

programming problem for you to work out. If you are happy with your solution, send it to the BASIC Forum and we will publish the best of those received.

Here is the problem: Write a program that will input a number, say n , then print a list of all prime numbers between 1 and n . A prime number is divisible only by itself and one.

As a benchmark test for your program enter $N = 1000$ and measure its RUN time. Send us this information and other pertinent details such as which BASIC you are using and the type of output device. We will use the time measurement more to compare your algorithms (solution procedure) than to rate your BASIC interpreter. Write to:

The BASIC Forum
P.O. Box 7082
Tyler TX 75711

NEXT: LOOPING — A case for "going around in circles!"

BOOKS BOOKS BOOKS

from page 11

one-dimensional arrays. FOR-NEXT statements illustrated with programs

for summing and finding averages. The remainder of the chapter is devoted to problems involving the manipulation of lists of numbers.

Chapter four describes the use of functions found in most BASICs as well as the application of user-defined functions. Programs involving computation of prime numbers and greatest common factors are presented to illustrate the use of functions. The random number function, sorting techniques, and modular arithmetic complete this chapter.

Elementary data processing concepts appear in chapter five where the reader is shown how to tabulate results of surveys and questionnaires. The DIMENSION statement and two-dimensional arrays are also introduced.

Data for programs in the first portion of the book are either contained in DATA statements or assignment statements. Chapter six introduces the INPUT statement and data entry directly from the keyboard. At this point, nearly all of the standard BASIC statements have been introduced and the reader should be prepared for the programming techniques covered in the remainder of the book.

Chapters 7 through 13 include applications mostly of a mathematical nature. Among the topics considered are the following: Number Manipulation — Factoring, Solutions of Quadratic Equations, Applications to Trigonometry, Complex Numbers, Zeros of Polynomials, Matrix Manipulation, Probability Applications.

Although the chapters presenting BASIC statements need little mathematical familiarity, the application chapters require some knowledge of high school algebra for full appreciation. Coan's book offers considerable insight into problem solving in BASIC, and would make a fine addition to your personal computing library.

John Arnold
Tyler TX

LEGAL/BUSINESS FORUM

from page 6

insurance for purchasers of microcomputers like some stereo stores do for the merchandise they sell.

Other things a national association could do are negotiate discounts for its members on magazine advertisements and convention booths, provide centralized legal research on issues of importance to the entire industry and even coordinate and sanction conventions and shows.

Perhaps the most important thing a national association could provide is *clout*. For instance, by statute in California, retailers who perform warranty work for manufacturers providing a written warranty are entitled to reimbursement for their time, including a reasonable profit. I have yet to talk to a store owner who has been paid by a manufacturer for providing warranty service. The California statute provides for treble damages, court costs and attorneys fees if a law suit need be brought. No store owner has yet sued a manufacturer because of the fear that if they do the manufacturer will no longer sell to them. However, if the association organizes a class action, the manufacturer can't take punitive action against all stores in California. More on warranty in a later Forum. Clout can also be used against manufacturers who fail to fill orders or who sell a "complete system" without actually having produced one of the components. The implications for the customer are obvious... better warranty service, less waiting to receive purchases, no problems with "phantom" products, etc.

The previous discussion only points up some of the potential services which a national association of computer store owners could provide. I'm sure store

owners could think of plenty more. I am also sure some of my suggestions are not viable for one reason or another. So be it. The services to be provided should be dictated by the association members and no one else.

Getting The Ball Rolling

Actually, the ball is already rolling. In conjunction with the National Computer Conference in June, 1977, Portia Isaacson, the Conference Chairperson and a computer store owner, arranged for a meeting of store owners.

At that meeting, chaired by Ray Borrill of the Data Domain, and attended by thirty to forty store owners, I presented a proposal for the formation of a computer retailers' association. My proposal consisted of the purposes and services discussed above along with a proposed budget and by-laws. As I see it, such an organization would be a nonprofit corporation whose officers and directors would be store owners. Its day-to-day activities would be managed by a full or part-time executive director.

The proposal was generally well received. Of course, not everyone there agreed that all the proposed services were desired and others were suggested. But everyone agreed it would be a very good idea to form such an association. As usual with these types of meetings, there was a lot of constructive talk but not much action. The formational stages in the development of national associations can be a vicious circle. It takes people, committees and money to get them going, but most people don't want to commit their time or money until the organization comes into being. For that reason I proposed the following plan of action.

I will establish an interest-bearing Computer Retailers' Association Trust Account. All store owners who are interested in

forming a national association should send me a \$100 check made out to "Computer Retailers' Association Trust Account." With your check include all of your comments and ideas. If you want to see my proposal and comment on that, please write me for a copy. On November 30, 1977, I will prepare a report for all who have contributed to the Trust Account. If twenty persons respond (it takes twenty members to form a trade association in California) the report will consist of a list of contributors, a set of revised proposed by-laws and a ballot for choosing members of a committee to finalize the articles of incorporation and by-laws. The committee members will probably also serve as the initial board of directors. The Trust Account will be turned over to the committee to get the association formed and underway. If less than

twenty persons contribute, the report will so indicate and include a check refunding the \$100 plus interest.

So, store owner, you don't stand to lose a cent. Like I said the XYL is the chancellor of the exchequer around here and as a banker, she doesn't miss a trick when it comes to money. It was her suggestion to make the Trust Account an interest bearing account.

Don't miss out on the opportunity to have the association plaque displayed in your store window state "Charter Member."

Microcomputer manufacturers will probably be watching closely. They can have an association too, you know.

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THE HEATHKIT FORUM

from page 4

word came in "The President's Corner" of the Winter 1977 Heathkit catalog: "And what about the most asked question, and that is what are we doing about computer kits? I assure you we are most active, and I have no hesitation to say that you will be greatly pleased with what's coming. An announcement will be made prior to our shipping date, so please be patient with us."

My own reaction was to dash off a letter to Heath Co. president, David W. Nurse: "Your letter in catalog 814 reassures me that we shall soon see the day when any Heathkit using digital circuitry can

easily be linked into a home computer system. This will make possible such applications as computerized weather forecasting using Heathkits to measure time, temperature, and wind speed and direction. We shall also have computers linked together through Heathkit radios and telephone dialers displaying information by direct video input to Heathkit TV."

That's enough of my enthusiasm for now. The

family dictionary recognizes "forum" as "a medium of open discussion." Let's hear what you have to say about Heathkit computers. Do you plan to get one? Why or why not? Which Heath system do you prefer and why? What do you like and dislike about Heath's initial entries into the computer kit field? What would you like to see them do in the future? Or maybe there are questions you'd like other reader's help with. In any

case, please write to:

The Heathkit Forum
c/o Charles Floto
267 Willow Street
New Haven CT 06511

LETTERS

from page 15

of information: The word

robot was introduced by the author Karel Capek in the 20s or 30s in his play "R. U. R." for Rossum's Universal Robots. (Robert Rossum, huh?)

For those who may turn up their noses at robots and mechanical men, let me point out that most societies build their base of power on many kinds (one being slaves, or servants, or machines), and our next big leap may be due to the development of a practical robot. I'd love to see some kind of concentration in KB on all those things necessary to robots, i.e., portable micros, electronic to mechanical translation, sensor development, flowcharting for programming and interaction with the outside world.

Finally there is a most important need — good press. Hollywood has created the wrong attitudes for robots, computers and their creators in perhaps 95% of their mention. Non-technical people I have talked to about this make no bones about the fact that they are distrustful and downright frightened of artificial intelligence. Why haven't we seen micros on the popular TV shows, and not as antagonists but as heroes? Science has had a hard time since Hollywood's version of Frankenstein, and now it's Proteus attacking the promise of technology. To those in power, please present a more rational and informative view to the public about these new tools. They may be our salvation.

So much for philosophy and all that, carry on the good work.

Bert Thiel
Frostburg MD 21532

Right. C. S. Pepper's name should have been mentioned in the article's references. (He was not the designer, however. His article dealt with a modification of the circuit.)

With regard to material on robots ... we haven't been actively looking for it, and it hasn't been coming in by itself either. It does seem to be going to Byte and

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Interface Age (which is okay). If three magazines were concentrating on the subject I think that would be a bit much. — John.

PUBLISHER'S REMARKS

from page 2

hi-fi addicts do as I do . . . buy the record and make a cassette of it for general use.

The Heath Computers

A lot of us are going to be interested to see what the reaction is to the Heath H11, the 16-bit LSI-11 computer system. I've heard a lot of pros and cons about being a member of Decus. The pro side points out that this enables you to get the huge catalog of programs which are available very inexpensively. The con people say yes, you get the catalog, but when you start looking for practical programs they aren't there. How many people really want a program to calculate the change in weight of the Great Pyramid of Giza when the moon passes overhead? That is an exaggeration, obviously, but I think that all *Kilobaud* readers would like to have some practical advice on the subject . . . what is available from Decus . . . and how much does it cost?

I'm a little perplexed and concerned over the decision by Heath to sell the new system only by direct sale and through their few (about 50) stores. This may in the long run put them at a serious sales disadvantage over firms like Southwest Tech who are selling their kits through computer stores. There is a lot to be said for being able to get help with your system from a nearby store . . . and, as programs become available in large numbers, I think we'll see most computer owners checking in to see what's new in programs for

their systems at the local store.

The Heath systems look very attractive . . . and being kits they are ripe for hobbyist action such as a modification to use the Z-80, a 50/100 bus interface so Altair and other S-100 bus boards can be used, etc. The paper tape system has been needed by many hobbyists, and should soon be interfaced with all of the popular systems. We should be running a lot of interesting articles.

Kilobaud Users Groups

If you've worked up any information which you think others using your system might need, why not send it in for inclusion in a Users Group section of the magazine. This will help KIM, SWT, and users of all the other relatively popular microcomputer systems.

Articles Needed

There is so much to write about it is difficult to start with a list. How about an article on starting a computer store? We still need a comparison of the many cassette systems . . . a comparison of the more popular bus structures . . . and the Altair bus could provide a whole series of articles . . . one on the many varieties of standards for the S-100 bus . . . another listing the many memory boards available for the S-100 and the differences between them . . . and how about a list of the boards available for the bus? Has anyone some good ideas on improving the S-100 bus setup?

Future Terminals

Nishi, the editor and publisher of the new Japanese hobby computing magazine, *ASCII*, flew over for the NCC show in Dallas. He brought me the latest in calculators, just released the day before his trip. This was

a Sharp EL-8130 Elsi Mate and the surprising thing about it is that it is less than 1/5th inch thick!

The Elsi Mate is 2-5/8" wide by 4-7/8" long and so thin that no one can believe it. This calculator has a touch pad for the numbers which does not move. Every time you press a number there is a little musical tone to let you know you've entered the number. The calculator has a memory function, square root, etc. The readout is liquid crystal and it works like a charm.

It is a lot of fun sporting a fantastic toy like this . . . but even more important to me is what this portends. I can see a terminal built along the same general line with a liquid crystal display instead of a television set or CRT. The keyboard will work just fine for most people for casual computing. Office type computers will want to use the old-fashioned movable keys which are better for trained typists. Remember that less than 1% of the people in the country are trained typists and presumably would easily adapt to non-moving keying-in of data on a computer terminal. That musical tone helps a lot.

Thus we may see a terminal that looks more like a hard cover book. The cover would open up to show the liquid crystal display (LCD), and the display generator chip and a couple of pages of memory would be under the flat keyboard. With batteries it might be only a half inch thick.

Would we connect to the computer by wires, by a UHF radio link, or by a little plug-in glass "wire"?

How much would a terminal like that cost? It could go under \$100 . . . maybe under \$50. Would you believe \$20? Put me down for a dozen.

Flying The Fairchild

Since the game cartridges for the Fairchild Video Entertainment System just houses ROMs, it stands to reason that an enterprising

hobbyist should be able to rig up a plug-in unit which will turn the whole thing into a microcomputer. Let's see what you can do with this \$170 system.

New England Vacation

Since the chances are good that you'll be coming to Boston for the **COMPUTERMANIA** exposition, why not take a few more vacation days and see what everyone is making all the fuss about?

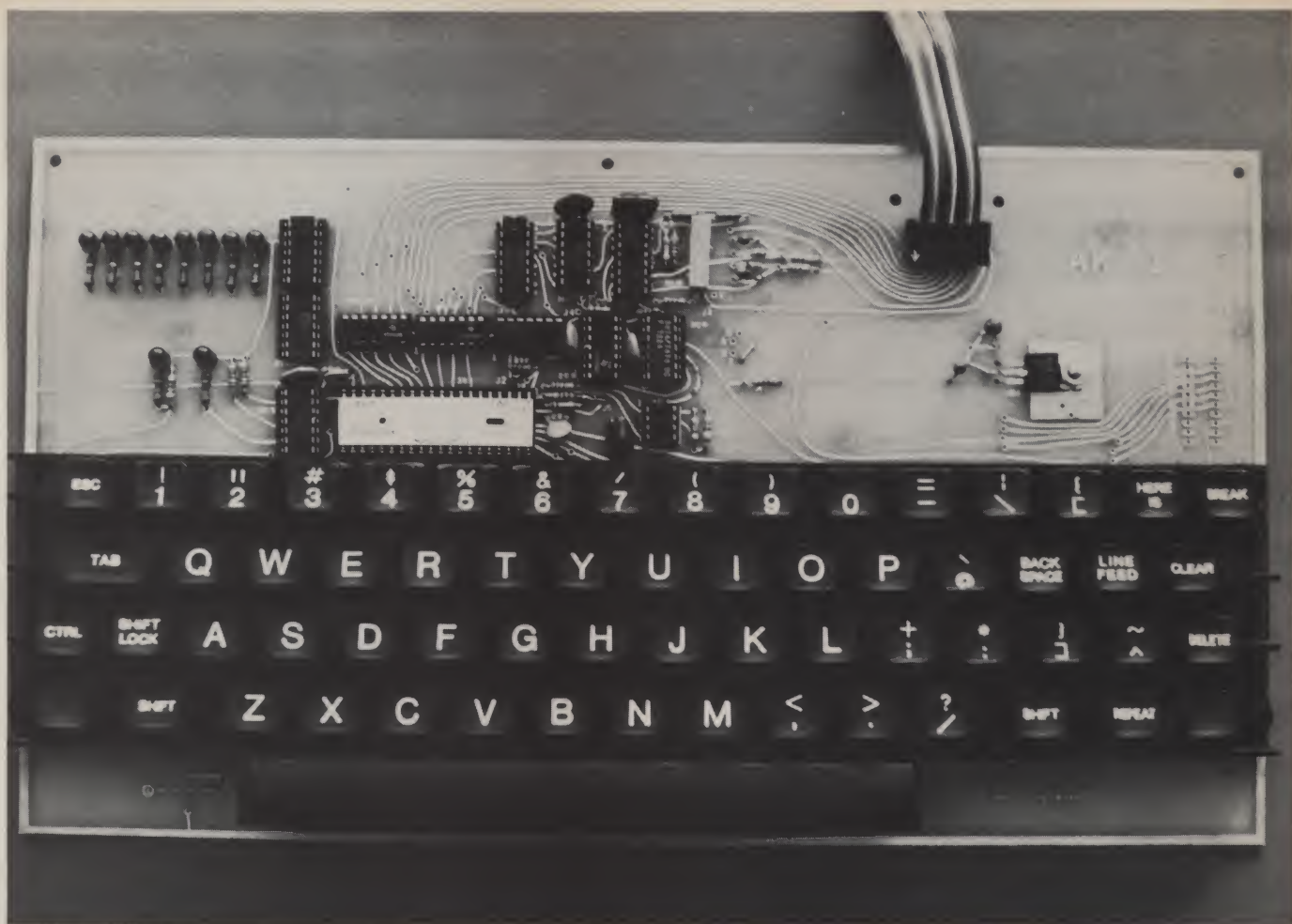
Just about an hour south of Boston is one of the most famous vacation spots in the country: Cape Cod. Here you'll find fantastic seafood, hundreds of motels and some of the best shopping in the country. You might even want to put in some beach time — the Atlantic Ocean is just right at this time of the year.

To the north, also about an hour away, is New Hampshire. It's another hour up to the White Mountains — one of the most beautiful parts of the entire country. You'll want to see The Flume . . . and the Basin. You'll want to take a ride up the first North American aerial tramway on Canon Mountain. The scenery is breathtaking. A little further on you can drive the Toll Road up Mount Washington — a drive you won't forget. That's even more breathtaking.

If you head up Route 95 instead of 93, you'll soon find yourself in Maine. The little coastal villages are wonderful to visit . . . see Kennebunkport. Up further you'll want to stop for dinner at the Red Lion in Bangor and the drive down to Acadia National Park on Mt. Desert Island. For heaven's sake don't miss the afternoon tea in the park . . . fresh hot popovers with jam and homemade ice cream. That's worth the trip.

You'll find the last week of August a great time to vacation . . . it's just before Labor Day weekend when it

continued on page 46



Fully assembled ASCII keyboard.

*Robert Brehm
1095 Sherman Ave.
Menlo Park CA 94025*

There comes a time in every computer hobbyist's life, after he has put his computer kit together and before he has invented the software program to control the world, when he has to choose an ASCII keyboard to talk with his digital creation. This article is written to help him make this momentous decision by describing an inexpensive, yet versatile, ASCII keyboard kit which features both parallel and serial output in standard TTL and RS232C formats. After reading this article, the computer hobbyist can purchase the kit or apply the ideas to any keyswitch assembly and convert it to an ASCII keyboard for use with his computer.

The keyboard to be described in this article can be put together from readily available parts sold by surplus dealers or it can be purchased as a kit from Microtronics for \$89.95 which includes all options and a 45-page technical manual.

The construction technique, theory of operation, computer interfacing and troubleshooting ideas described in the technical manual provide a foundation that the computer hobbyist can use to build a flexible, inexpensive keyboard. This article presents excerpts from the manual in the hope that the information will help the hobbyist increase his technical understanding of keyboards in addition to providing him with practical information for building ASCII keyboards based on ROM encoders.

Keyboard Features

The AK-1 ASCII keyboard from Microtronics utilizes the SMC KR2376-30 ROM which is a MOS 2376 bit read-only memory. This 40-pin chip contains all the logic needed to encode single-pole single-throw switch enclosures into a standard USASCII seven-bit code plus parity. The ROM also features strobe polarity selection, two-key rollover, keyboard debounce and static charge protection of all input and output terminals.

In addition to the ROM, other circuitry incorporated into the keyboard design provides parallel output and simultaneous serial output for driving a cassette recorder or other serial device. Both latched and unlatched strobes are available with either positive-going or negative-going logic which enables the

keyboard to be connected to virtually any computer and provide full handshaking capability.

Other standard features of the circuit to be described include the following: electronic shift lock and unlock; odd or even parity selection; uppercase only or upper and lower case operation; two key rollover, N-key lockout; four modes: control, shift, normal, user-defined; repeat circuit that works in any mode; fully buffered outputs for high drive capability and ROM protection; one piece molded plastic keyswitch assembly for keyboard rigidity; premium grade double-sided plated-through PCB; ample power supply bypassing; sockets for all ICs; serial interface (10 cps or 30 cps standard) with TTL output (positive or negative logic), RS232C output, and 12 V

Build Your Own ASCII Keyboard

... with serial and parallel output

regulator circuitry; LED indicators: ASCII code indicators (one per bit to serve as visual key depressed feedback or to check on data code transmitted), shift and control indicators (when shift key or control key is depressed LED is lit); voltage regulators: five volt regulator circuitry, twelve volt regulator circuitry.

Power supply requirements for the AK-1 are +5 V dc, -12 V dc and optionally +12 V dc (only if serial RS232C output needed). These supplies should be well regulated and should be free of transients.

Parts Selection

There are several ways to build a keyboard around the KR2376 encoder chip depending upon where you want to start. If you start from scratch with only the

ROM, you have to gather together all the other ICs, the resistors, capacitors, and any other components. More important, you must find a keyboard which has the needed keyswitches. Then, after all the parts are gathered, you have to wire it up and hope that it works. With the information given here, a competent electronics technician can probably accomplish this task without too much trouble. Since the parts used in the design are usually readily available and the keyswitch assembly is sold by many surplus stores, this approach is certainly one to consider if you require a custom keyboard and have the time to gather and assemble the parts.

A second, more realistic, approach is to order the AK-1 kit from Microtronics. The advantages are many. First,

you only buy the parts needed for your configuration. Second, you get ICs that have been 100% tested prior to shipment. You also get resistors and capacitors that are chosen specifically for the physical and electrical requirements of this circuit layout. In addition, you get a premium double-sided, plated-through printed circuit board which eliminates most of the point-to-point wiring found in many home brew design. Moreover, you deal with only one supplier who specializes in serving the computer hobbyist.

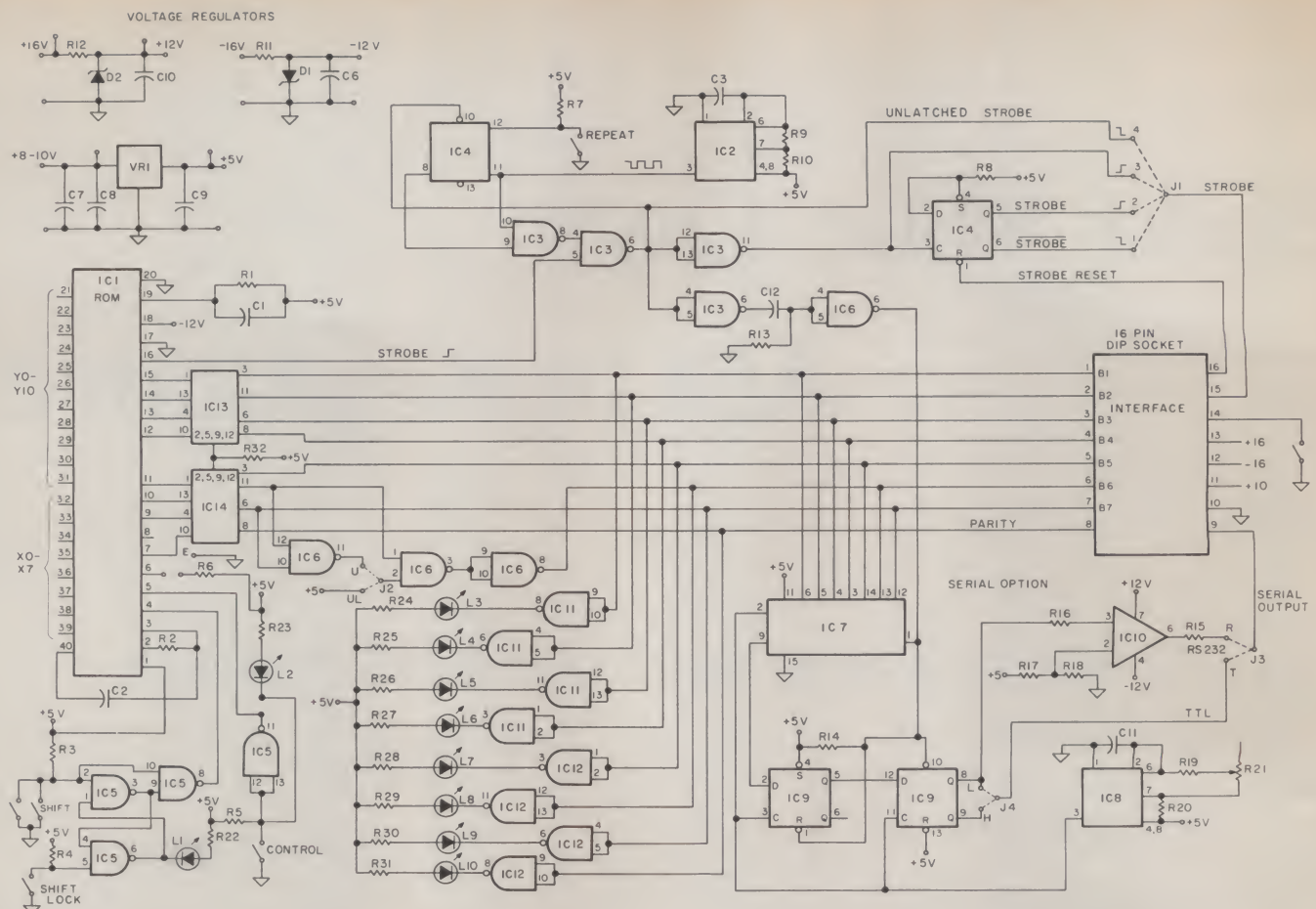
A complete schematic and parts list for the AK-1 is shown in Fig. 1 and Table 1.

Functional Block Diagram and Theory of Operation

The operation of the AK-1 ASCII keyboard can be easily understood by examining the

functional areas consisting of the ROM, Shift, Repeat, Strobe, PISO, RS232C, voltage regulators, and LED indicators. A functional block diagram consisting of all of their circuits is shown in Fig. 2. Refer to this diagram and the schematic in Fig. 1 for the following discussion.

ROM circuit: The SMC KR2376-30 ROM is a 40-pin MOS keyboard encoder with all the logic necessary to encode single-pole, single-throw keyboard switches into ASCII code. This IC features TTL/DTL outputs, 2-key rollover, N-Key lockout, self-contained oscillator, a delay network to eliminate the effect of contact bounce, and static charge protection of all input and outputs. In addition, external control is provided for even or odd parity selection. External circuitry has also been added



Capacitor	Value (uF)	Type	Resistor	Value (Ohms)
C1	.001	disc	R1	680k
C2	47 pF	disc	R2	100k
C3	.1	mylar	R3-R8	2.2k
C4-C5	.1	disc	R9-R10	470k
C6	1.0	tantalum	R11-R13	510
C7, C9	.1	tantalum	R14-R15	2.2k
C8	15	tantalum	R16	47k
C10	1.0	tantalum	R17	4.7k
C11	.1	mylar	R18	3.9k
C12-C14	.1	disc	R19	2.2k
			R20	47k
			R21	10k
			R22-R31	330
			R32	2.2k

IC No.	Type
IC 1	KR2376-30
IC 2	555
IC 3	7400
IC 4	7474
IC 5, 6	7400
IC 7	74165
IC 8	555
IC 9	7474
IC 10	741
IC 11, 12	7400
IC 13, 14	7408

Diode	Type
D1	IN5242 zener
D2	IN5242 zener

VR1 is a 5V regulator

Fig. 1. ASCII keyboard schematic diagram.

to allow upper case only or upper and lower case only selection.

The X-Y matrix wiring chart for the full ASCII character set is shown in Fig. 7. Each X_i , Y_j switch can generate three different codes depending upon the voltages present on the shift (S) and control (C) inputs. Mode selection logic is shown in Fig. 3.

The control function is enabled by grounding a 7400

NAND gate which also causes the control LED to light. Unlike the shift circuit, the control mode requires the continuous depression of the control key.

The RC (R1 C1) circuit on pin 19 of the ROM provides a strobe delay of 1.5 ms after the data on the output has become valid. The RC (R2 C2) circuit on pin 2 of the ROM sets the debounce oscillator frequency to 50 kHz.

Shift circuit: The AK-1 features an electronic shift lock circuit. It is not necessary to hold down the shift key to obtain upper case operation. All you have to do is tap the shift lock key. To revert to lower case operation just tap the shift key. If you want to shift for only one character, just hold the shift key down for that character. The circuitry is a set/reset flip-flop made with two sections of a 7400 NAND

Standard Parts Kit

Integrated Circuits

- 1 - KR2376-30 ROM (IC 1)
- 1 - 555 (IC 2)
- 3 - 7400 (IC 3, 5, 6)
- 1 - 7474 (IC 4)

Resistors

- 7 - 2.2k Ohm, 1/4 Watt, 5%
- 1 - 680k Ohm, 1/4 Watt, 5%
- 1 - 100k Ohm, 1/4 Watt, 5%
- 2 - 470k Ohm, 1/4 Watt, 5%

Miscellaneous

- 1 - Keyswitch assembly
- 1 - AK-1 PC board
- 1 - 16 pin DIP socket

Optional Parts List

LED Indicator Kit

- 2 - 7400 ICs
- 10 - 330 Ohm, 1/4 Watt, 5%
- 10 - Light Emitting Diodes
- 1 - .1 uF disk

Serial Interface Kit

ICs

- 1 - 74165 (IC 7)
- 1 - 555 (IC 8)
- 1 - 7474 (IC 9)
- 1 - 741 (IC 10)

Cs

- 3 - .1 uF disk
- 1 - .1 uF mylar
- 1 - 1.0 uF tantalum

Regulators

- 1 - 1N5242 12 V, 1/2 Watt

- 2 - 7408 IIC 13, 14)

Capacitors

- 1 - .1 uF mylar
- 1 - 47 pF disk
- 1 - .001 uF disk
- 4 - .1 uF disk
- 1 - 1 uF tantalum

- 1 - 40 pin DIP socket
- 1 - Hardware package

Voltage Regulator Kit

- 1 - 12 V dc, 1/2 Watt zener diode
- 1 - 510 Ohm, 1/4 Watt, 5%
- 1 - .1 uF disk
- 1 - 15 uF tantalum
- 1 - 340T-5.0v or 7805 UC

Rs

- 2 - 510 Ohm, 1/4 Watt, 5%
- 2 - 2.2k Ohm, 1/4 Watt, 5%
- 1 - 47k Ohm, 1/4 Watt, 5%
- 1 - 4.7k Ohm, 1/4 Watt, 5%
- 1 - 3.9k Ohm, 1/4 Watt, 5%
- 1 - 30k Ohm, 1/4 Watt, 5%
- 1 - Timer Potentiometer*
- 1 - Timing Resistor**

Speed

- | Speed | * | ** |
|--------|-----|------|
| 10 cps | 50k | 33k |
| 30 cps | 20k | 2.2k |

Table 1. AK-1 ASCII keyboard parts list.

gate with some additional gating to reset the flip-flop when the shift key is touched. When the shift lock is hit, IC5B output goes low and causes the LED to light. At the same time, IC5C goes high enabling the shift function in the ROM.

Strobe circuit: The strobe circuitry used in the AK-1 allows maximum flexibility in choosing a strobe pulse that is compatible with your micro-computer. Both unlatched and latched strobes are provided which may have either positive-going or negative-going logic. The unlatched strobe is present as long as the key is depressed; the latched strobe is present after the key is depressed until it is reset by the computer. Each new strobe pulse will set the latch after it has

been reset. After each character is read by the computer, it should reset the latch in order to recognize the next strobe from the next character.

The latch used in this circuit is a 7474 edge-triggered flip-flop which is hardwired to provide +5 V on pin 5 whenever a strobe is present (called a positive-going strobe, \uparrow), otherwise it will be zero when reset by the computer. Pin 6 of IC4 provides the opposite type of latched strobe; one going from 5 volts to zero volts (called a negative-going strobe, \downarrow).

Depending upon your computer input requirements, you may select the latched or unlatched strobe by placing jumper J1 to the appropriate

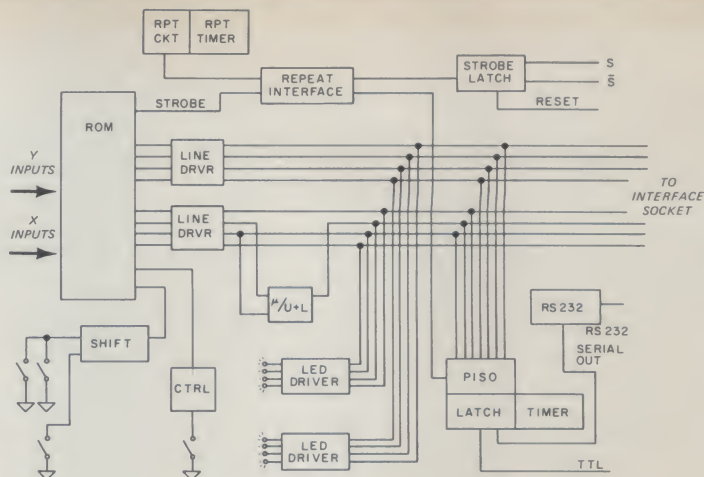


Fig. 2. AK-1 functional block diagram.

strobe.

Repeat Circuit: The repeat circuit consists of two functions, the timing and the clocked repeat section. The timer is a 555 wired for a stable operation at approximately five characters per second. Higher or lower speeds may be obtained by changing resistors R9 and R10. However, the repeat clock speed must be less than or equal to the serial output clock speed, if it is used, in order to prevent data overrun. Clock pulses are fed into pin 11 of IC4 which is hardwired to provide a logic 0 (low) \bar{Q} output when the repeat key is not depressed. This is fed to IC3A and has no effect on the strobe going into IC3B since IC3A output is high. When the repeat key is depressed, \bar{Q} goes high and the clock pulses are routed through IC3A to IC3B. When the strobe is high into IC3B, the clock pulses are fed to IC3C, inverted and used to clock latch IC4B. When the repeat key is depressed or released, the D flip-flop ensures that the repeat clock pulses always end on a level transition rather than during the pulse, thus providing timing independence of the repeat key and a predictable number of repeated characters.

PISO circuitry: The Parallel-In-Serial-Out (PISO) circuit is probably the most

complex of the functions besides the ROM itself. It provides keyboard users the option of using serial interface through two wires (signal, ground) rather than nine wires (eight parallel output, ground) to their computer. It also gives the capability of simultaneous parallel and serial output which allows one keyboard to input data to the computer and simultaneously input data to a cassette via a cassette interface.

The PISO function consists of a timer and a 10-bit shift register made up of an 8-bit shift register (IC7) and two-bit flip-flops (IC9). The timer is set to 110 Hz for 10 cps or 300 Hz for 30 cps. A ten-turn potentiometer is provided to adjust the frequency to that used by your serial interface.

The PISO is driven by the strobe circuit through IC3D and IC6A which serve to convert the strobe level change to a narrow .5 ms negative-going (\downarrow) pulse. Under steady state conditions, when no character is being sent, pin 9 of IC9 is high (+5 V) which represents a mark. When a key is depressed, the strobe pulse sets IC9B, thus forcing Q, or pin 9 of IC9B to remain high for the start of the serial bit stream. This 1 can be any width, from nothing to slightly less than one clock

$\overline{SC} = N$ (Shift Control keys not depressed)
 $SC = S$ (Shift key depressed)
 $SC = C$ (Control key depressed)
 $SC = \text{Invalid}$ — spurious data (Both keys depressed)
 where $\overline{S}, \overline{C} = 0, 0$ volts, $S, C = 5, 5$ volts
 $N = \text{Normal}, S = \text{Shift}, C = \text{Control}$

Fig. 3. Mode selection logic.

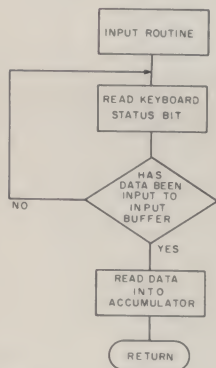


Fig. 4. Keyboard input subroutine.

cycle width, since the strobe pulse can arrive at any time with respect to the beginning of the clock cycle. Consequently this output 1 is probably a short bit and is used to absorb the difference between clock timing and the instant the strobe is detected.

At the same time the strobe set IC9B, it reset IC9A, Q, to low. Therefore, during the next clock pulse a space or logic 0 is transmitted signifying the start of the serial character.

The rest of the code, loaded into IC7 during the strobe, will follow in sequential order. The parity bit is hardwired to be high at all times. After these 8 bits, 2 logic 1s are transmitted signifying the end of the character. Until the next strobe pulse, the output is held in the mark position (logic 1).

RS232C interface: The RS232C interface requires -12 V for a mark and +12 V for a space with the same 11-bit character stream as provided in the serial TTL output previously discussed. Consequently all we have to do is provide a logic level shifter to do the voltage changes. The versatile 741 op

amp performs these functions nicely.

The output of IC9B is Q, which is low for mark. Consequently, when 0 volts are applied to the + input of the op amp, the output will go negative and vice versa during space or logic 1 input.

Either serial output may be selected via jumper J3. In fact, both serial outputs may be used simultaneously if you have the capabilities to utilize them. (Thus providing three simultaneous outputs from the keyboard!)

Jumper J4 selects positive or negative logic for the serial TTL output.

Voltage regulator circuits: Both the ± 12 volts regulator circuits utilize zener diode regulators since the current drawn by the keyboard circuit is very small. A 1 μ F capacitor is provided on the output for transient suppression and high frequency smoothing.

The five volt regulator utilizes a 7805 or 340T-5 voltage regulator rated at 1 Amp. Since the fully loaded keyboard draws only 350 mA at 5 volts, this regulator is well within its ratings. Two input capacitors are included on the input for regulator stability and decoupling. The output capacitor helps transient response.

LED indicator circuit: The 8-bit parallel output line is coupled to the LED ASCII code indicator via 7400 NAND gates configured as invertors and acting as LED drivers. When an ASCII bit is high (+5 volts) the output of the LED drivers will be low, causing the LED to draw current.

During standby, all inputs will be high and consequently all LEDs will be lit. The LEDs are arranged on the keyboard such that the rightmost LED represents the least significant bit (B1) and the leftmost LED represents the parity bit (B8). The ASCII code for any depressed key will be shown on the LEDs as a lit LED for 1 and a dark LED for 0. It is very interesting to watch the parity bit change as the code changes. With even parity, you should always have an even number of LEDs lit and with odd parity an odd number should be lit in the upper and lower case mode.

Computer Interfacing

Interfacing the AK-1 to your microcomputer should be very easy due to the flexibility of the interface circuitry. The hardware and software ideas presented here should enable you to successfully interface your keyboard to most, if not all, I/O interface boards on the market today.

Parallel interface: The polarity of the parallel data output is hardwired for positive logic with +5 V = "1", or 0 V = "0" since this

type of logic is the most commonly used for hobbyist applications. If your computer programs require negative logic, it is an easy matter to complement the ASCII character via software to obtain this result.

The ASCII output of the AK-1 keyboard is not latched as most interface boards have on board 8-bit parallel latches. This means that the data is valid on the output lines only as long as the strobe or data available signal is valid. As a result, your software computer program must have some way to recognize when to read the ASCII character on the data lines or in the I/O board latch. This is typically done with a status bit in a status word or 8-bit channel (as used on the 3P+S) or a status bit on a flip-flop. In either case, the status bit is set by the strobe from the keyboard. With the AK-1 you have a choice of a latched or unlatched strobe with either positive-going (0 V to +5 V) or negative-going (+5 V to 0 V) logic. In general, if your I/O interface board *does not* have a status bit latch circuit, then you should use the latched strobe available from the keyboard. If you do have an on board latch (or flip-flop), then you can use the unlatched strobe from the keyboard. Your I/O interface board manual will tell you whether you need a negative-going (STROBE) or positive-going (STROBE) strobe. Choose the appropriate strobe by placing jumper J1 to the appropriate hole.

READ	IN	STATUS	READ STATUS BIT
	ANI	40H	LOGICAL "AND" WITH (01000000B)
	JZ	READ	NOT READ, TRY AGAIN
	IN	DATA	READ DATA INTO ACCUMULATOR A
	RET		RETURN TO MAIN PGM
STATUS	EQU	02H	(STATUS PORT)
DATA	EQU	03H	(DATA PORT)

Fig. 5. 8080 machine language program to read keyboard data. Program first checks keyboard status bit for a 1 value, then reads value into Register A.

LOOP	CALL	READ	(PREVIOUS SUBROUTINE)
	CMA		COMPLIMENT DATA FOR LEDS
	OUT	OFFH	FF IS FRONT PANEL OUTPUT PORT
	JMP	LOOP	JUMP TO NEXT CHARACTER

Fig. 6. 8080 program to display keyboard data on front panel lights of Imsai 8080 requiring complement logic.

If you use the latched strobe, you have to provide a negative going (\square $\begin{smallmatrix} +5V \\ 0V \end{smallmatrix}$) reset pulse to the reset terminal of the strobe latch. Many I/O boards generate this pulse automatically when a read command is executed by the software program. If your I/O board has an on board latch, the signal is probably generated on board to reset the latch so you don't have to do anything.

Serial Interface: If the optional serial interface kit is purchased for the AK-1, you can use a serial port on your I/O board for the keyboard interface. If, on the other hand, you use a parallel interface to your microcomputer, you can use the serial interface to drive any of the popular cassette interface boards on the market today. In either case, you have to properly set the timing of the serial bit stream.

Interfacing serial data to your computer requires several steps. First, you must determine what voltage levels your serial port requires. The AK-1 can supply TTL levels with mark = +5 V and space = 0 V or standard RS232C levels with mark (logic 1) =

-12 V and space (logic 0) = +12 V. For either voltage level, no strobe is needed since it is part of the serial data stream. After the voltage level requirements have been determined, the speed must be chosen. The AK-1 can be wired for either ten characters per second (teletype-writer speed) or for 30 cps. Since most people can't type 10 cps, either speed is quite satisfactory and the choice depends on the speed capability of your I/O interface board. Once you have chosen the speed and set the speed on your I/O board, you have to adjust the timing potentiometer on your keyboard. Before you do this, check that you have the proper timing resistor for the speed you have chosen. For 30 cps R19 = 2.2k, and R20 = 47k; for 10 cps R19 = 33k, R20 = 30k.

The correct method to adjust the frequency utilizes a frequency counter or triggered oscilloscope. If you have a frequency counter, adjust the 555 timer output (pin 3) for 110 Hz for 10 cps or 300 Hz for 30 cps. If you have a triggered scope, press any key, measure the serial output and adjust one ASCII bit

for 9.0 ms for 10 cps or 3.3 ms for 30 cps.

Software Considerations

Now that you have the hardware interfaced correctly to your I/O board, it is time to try it out by writing a keyboard input program into your computer's memory. The software given in Fig. 5 is for the popular 8080 chip used by the majority of hobbyists.

In order to familiarize yourself with the required steps in the program, a program flowchart is shown in Fig. 4. Note that the sample program to be illustrated doesn't use hardwired interrupts but incorporates software interrupts as do the majority of computer hobbyist installations.

The code for either serial or parallel interface is the same as shown in Fig. 5.

In the main program, the input routine would be used by initiating a CALL READ statement after which the input data would be present in Accumulator A.

The program in Fig. 5 assumes that the I/O board strobe latch or the strobe latch on the keyboard is reset automatically via the hard-

ware. For serial data, the strobe on the UART (RDA) is normally reset by hardware. It has also assumed that the data port address was 03 and the status port address was 02 with the strobe or data available bit being B7. You may of course change port addresses and strobe bit position to suit your I/O board requirements.

If you want to check the code generated by the keyboard, and you have front panel indicator LEDs as does the Imsai 8080, you can run the program illustrated in Fig. 6 which puts the data on the LEDs.

The CMA, or complement accumulator, is required because the Imsai LEDs work on negative or complement logic with respect to the ASCII keyboard input.

Upper Case Only Section

Many AK-1 users will undoubtedly want to use the upper case only option which is jumper selectable on all standard keyboards.

By selecting upper and lower (jumper J2 to U+L) all upper case (shift), lower case (normal) and control character represented by the keyswitches are capable of being generated by the AK-1. If you desire switch selectable U+L or U only alphanumeric generation, a single-pole, double-throw (SPDT) switch can be installed on your keyboard case with the center pole going to hole J2 and the outside poles going to the U and U+L holes.

There you have it. A complete description of a keyboard with many options that should provide a versatile and flexible keyboard for hobbyist applications. You can now make the momentous keyboard decision and start to enjoy your electronic creation. Happy computing!

If you decide to order a keyboard from Microtronics, please include \$3 for shipping and handling and 6% tax (CA residents only) to: PO Box 7454, Menlo Park CA 94025 ■

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
	SUB LF SUB	SO SO SO	EN HT EN	• • •	• • •	US US US	SOH SOH SOH	SI SI SI	FS FF FS	DLE NUL DLE	ETB BEL ETB	N S C
X0	NAK ENQ NAK	/P SI	> SO	< FF	m CR	n SO	b STX	v SYN	c ETX	x CAN	z SUB	N S C
X1	 ESC	- US	LF LF LF	@ @ @	/	-	CR CR CR	B5 B5 B5	CR CR CR	MINUS MINUS MINUS	+ + +	N S C
X2	8 CAN	9 EM	ZERO ZERO ZERO	• SUB	- CR	j GS	~ RS	: FS	DEL DEL DEL	VT VT VT	SYN ACK SYN	N S C
X3	• SUB	 GS	NUL NUL NUL	DEL DEL DEL	• • •	STX STX STX	RS RS RS	ETX ETX ETX	SP SP SP	EOT EOT EOT	• • •	N S C
X4	• ESC	 FF	k VT	j LF	h BS	g BEL	f ACK	d EOT	s DC3	a SOH	FF FF FF	N S C
X5	@ NUL	p DLE	o SI	l HT	u NAK	y EM	t DC4	r DC2	e ENQ	w ETB	q DC1	N S C
X6	7 ETB	6 SYN	5 NAK	4 DC4	3 DC4	2 DC2	1 DC1	 ESC	DEL US	ESC ESC ESC	B5 B5 B5	N S C
X7												

Fig. 7. Key switches hooked up to the AK-1 keyboard. Chart shows the ASCII codes available in the KR2376-30.

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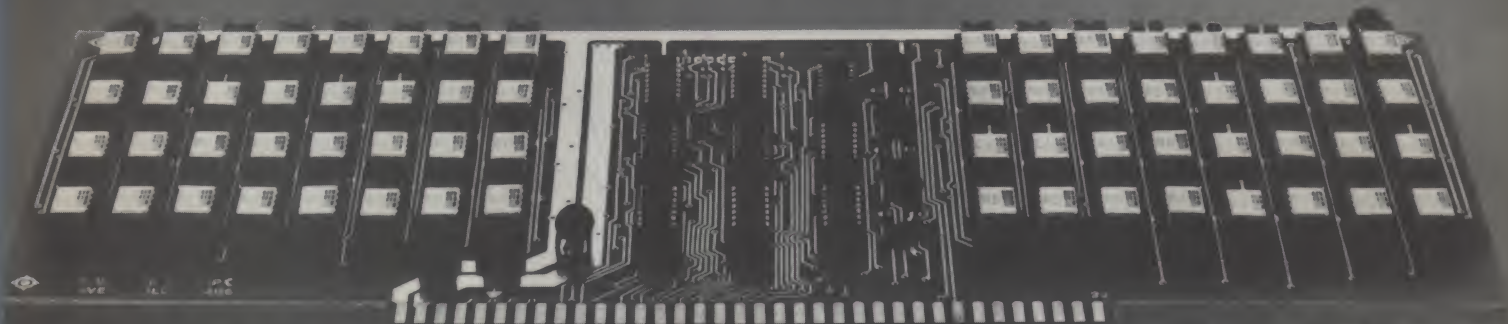
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The Ultimate Personal Computer

Forget learning the multiplication tables, compress college attendance into an afternoon, and master a new language in hours. Dick Tracy would have loved it.

Dr. Zeitlin has been involved with computing machinery since he was awed and partly deafened by the Aiken Mark II at Harvard in the late '40s. Subsequent exposures were to the pin-programmed Burroughs 101, the Bendix G15, the IBM 1620, and a very forgettable group of analog machines, among others. He is now professor of Industrial and Organizational Psychology on the doctoral faculty of Baruch College of the City Univ. of New York, and is president of Lakeview Research, Inc., a consulting firm. His experience with computers of ever-decreasing size and cost provided the premise for this article.

For several weeks last winter, I conducted an informal survey among my colleagues and graduate students, posing the question:

"How would you make use of a small, portable computer, capable of storing and retrieving information, performing mathematical calculations, and making logical

decisions?" About 15% of my respondents stated that they would use the computer's mathematical capability for assistance in job related calculations, statistics, engineering, etc. Another 5% proposed to use it in some non-job related fashion, including as a paper weight, to figure the odds at the racetrack, etc.

But the overwhelming majority, nearly 80% of those asked, would make primary use of the information storage function, largely as a memory aid. They would use it to store and recall names, addresses, phone numbers, and birthdays. They would load it with the factual content of course work or job related information, for retrieval as needed.

This last proposed use was expressed with great depth of feeling since the question was posed immediately prior to college examinations; a time in the life of any member of a college community in which information storage and subsequent retrieval becomes a matter of great import.

A Matter of Education

After reviewing the results of my informal survey, I began to wonder at the feasibility of this last use. Just how much information storage is required of a

college student?

At a first approximation we may be able to estimate the information storage requirement by assuming that a college education represents the accumulated sum of all the assigned course reading over a period of four years.

Let us take Paul Samuelson's *Economics* as a representative textbook. It contains 800 pages, 40 lines per page, with 15 words or 80 character spaces per line, for a total of 480,000 words or 2,560,000 characters.

If the typical requirement is two such books per course per semester, a college education represents 64 books; a total of 3.1×10^7 words or 1.64×10^8 characters. Coded in 7-bit ASCII format, a college education therefore represents 1.15×10^9 bits of information.

Now the current state of the art in solid state computer memory permits an information packing density of 6 mils³ per bit with integrated injection logic (I²L). Neglecting packaging materials and leads, this comes to about 1.67×10^8 bits per cubic inch of active volume.

A college education therefore represents 6.88 cubic inches of state of the art storage, about the volume of a king size cigarette flip-top box.

A common concern in my survey was the manner in which communication with the hypothesized computer would be accomplished. Most such communication requires the learning of a mechanical skill, keyboard entry, and a special programming language. My respondents felt that the computer would be of limited usefulness unless they could communicate to the computer as they would to another person in a natural spoken language and receive a similar auditory response.

Let's look at the state of the art in this. Several years ago, IBM reported 92+% accuracy over a wide range of subjects with a phoneme decoder about the size of a shoe box for input. I suspect the size is smaller and the accuracy is higher today. Also, English-like query languages for data base access are in active development in software houses throughout the country.

For output, synthesizers have been around for some time and are in commercial use in stock quotation devices, calculators, and reading devices for the blind.

Suppose then we approach the input/output problem on a verbal level; the user speaks to the computer, perhaps in a restricted or formalized query language, and receives a

synthesized speech response. No conceptual breakthroughs are required, merely miniaturization.

But, if we are going to communicate in the spoken word, why bother to encode all the characters of text? Why not code phonemes instead? This will cut the storage volume required by almost half.* Thus the information content of a college education could be stored in 3.7 cubic inches.

This volume is based on technology representing the current commercial state of the art. Within the last few months, a major semiconductor manufacturer has started preproduction runs of magnetic bubble static memories with storage capabilities of over 92,000 bits per chip. This permits an increase in information storage density of 22.5 times over the (12L) or CMOS memories used for the previous calculations. These and other new nonvolatile memories use little or no power in the resting mode. If we take advantage of this newest technology, a college education can be reduced to 0.17 inch³ or about 3 cubic centimeters.

As Easy as Pulling Teeth

This size is small enough to be conveniently implanted in the body, perhaps as a dental inlay or in the space made available by extracting a nonfunctional wisdom tooth.

I wouldn't want anyone to judge this argument on the inlay idea, but the mouth is, in fact, an almost ideal environment. We tolerate foreign bodies in the mouth quite well. Virtually everyone in the audience has a filling or an inlay, a false tooth, or a piece of bridgework. The

mouth is temperature controlled and serves as an effective heat sink. This location for the computer facilitates input/output communication, a piezoelectric crystal picking up the vibrations of speech and responding via bone conduction to the ear.

Indeed the saliva could act as an electrolyte for a wet cell which generates the power for operation. The only unusual design requirements are that the device be waterproof, shockproof, and nontoxic.

Thus obtaining the information incidental to a college education could be achieved as easily as pulling teeth — and in the same professional office.

But, you may well ask, despite the fact that the student receives his diploma with his dental bill, is this really an education?

The answer is an unequivocal NO — and an unfortunate YES.

It is really no more of an education than handing a student an armful of textbooks and granting him his degree; but, the latter is a fair characterization of present educational practices, and the inlay wouldn't be much worse.

Education, as we conceive of it today, may be considered a communications channel which conveys information from the printed page to the gray matter of the brain. Since the communication channel has such a low data rate and the brain's retention process is so inefficient, a prodigious amount of time must be spent in information transfer. If we assume that a student spends 40 hours a week for 9 months of each academic year reading the 3.1×10^7 words representing a college education, he has a data input rate of approximately 58 bits/second.

Judging by the typical performance on examinations, only about 1/10 of this information is retained, resulting in an effective trans-

mission rate of six bits/second from the printed page to the brain.

An oft-spoken criticism of contemporary education is that so much time is spent in the accumulation of information, that very little time is available to explore the use of that information. The direct implantation of *data* would solve that problem in a single stroke and could allow the educational process to direct itself to the integration and understanding of information rather than the accumulation of facts. In this respect the personal computer represents a potential technological breakthrough in education roughly on a par with the invention of moveable type.

No One Reads the Sky Anymore

Aside from purely pedagogical considerations, the economic implications of a personal computer are staggering. As a simplified example, consider my son's grade school. Our local school district spends nearly \$1,700/year/schoolchild. Approximately 15% of the educational time is directed to instruction in basic mathematics, largely rote learning of arithmetic. By the time the child has completed the fifth grade, the school system, and we the taxpayers, have spent \$1,275 to teach the child to add, subtract, multiply, and divide.

Now you and I know that we can buy the same skills conveniently packaged in the form of a pocket calculator at the local drug store for \$9.98. Furthermore, the calculator never makes a mistake — but my son often does.

When I expressed my misgivings at a teacher's conference about spending so much valuable educational time and money on rote learning an easily mechanizable skill, I was greeted with expressions of shock and disbelief. "How can anyone," I was asked, "function in our society without a thorough mastery of arithmetic?"

Yet, when I asked the time everyone in the room looked at his or her watch. No one glanced out of the window to ascertain the position of the sun in the sky. Not so long ago, however, the ability to tell time by the position of the heavenly bodies was also one of the marks of an educated person. But since the personal timepiece evolved into a ubiquitous artifact, telling time by the sky has been deemed a skill appropriate only for Boy Scouts, along with finding north by the moss on the trees, and building a fire by rubbing two sticks together.

In due time, perhaps in the next year or two, Mickey Mouse on my son's wristwatch may learn to count on his fingers as well as tell time by moving his hands. So too, after a somewhat longer period, the personal computer may become a ubiquitous artifact, a part of the natural scheme of things.

The overall consequence of this eventuality may well be a change in our normal method of intellectual functioning. The most immediate is the one we have already discussed, providing the data bank of education at all levels of schooling — not the methodology mind you, but the data.

Instant Retraining

Another, and perhaps equally important, consequence will be the possibility of instantly changing or updating learned bodies of occupationally relevant data.

It has been estimated that the half-life of a technology based job or education is about five years. That is, five years after learning a job or leaving school, half of what you have learned is obsolete. Retraining our adult work force has become an increasingly important problem. If present trends continue, a worker may well have to be retrained four to five times during his working life, with all of the lost time and emotional trauma that such

*Assuming 4 phonemes/word, the 3.1×10^7 words = 1.24×10^8 phonemes. The (32) phonemes of English can be encoded by a 5-bit code. Thus the information content is 6.2×10^8 bits equivalent to 3.7 in³.

drastic dislocation in life involves.

With the implantable computer it may ultimately be possible to change one's occupation with every visit to the dentist. Perhaps even do-it-yourself preprogrammed memories might be made available in such selected

art today or is likely to be so before this decade is out. The technology is here and the economic impetus is positive. Indeed, the personal computer capability suggested is *not* the ultimate individual system but rather an interim step. The ultimate computer might well be the size of a

With the implantable computer
it may ultimately be possible
to change one's occupation
with every visit to the dentist.

specialties as law and medicine as a substitute for post-graduate education.

Along a similar line, the courtroom lawyer might contain his law library in his molar, the tax accountant in his bicuspid. What a godsend for the doctoral student facing oral examinations!

On a less esoteric level, the individual contemplating an overseas trip may eschew Berlitz for an implanted foreign language dictionary. Imagine the effect of acquiring 10,000 words of Chinese in a two hour layover in Hong Kong!

The social implications of the implanted computer are equally as profound. If costs can be kept reasonable, as they probably will be judging by the price/performance manufacturing learning curve of pocket calculators and digital watches, the computer might well serve as a social equalizer divorcing access to data from income level. Note that human performance is still limited by intelligence and by the ability to use data itself.

When I first started this little paper my tongue was firmly lodged in my cheek. But, come to think of it, everything I have suggested is either within the state of the

grain of sand implanted in the brain at birth and as accessible to the brain as any other neuron.

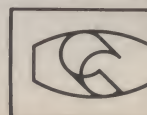
At the moment I would say that such a device was a practical impossibility. Not a conceptual impossibility, mind you, but a practical one. I would be willing to bet, however, that perhaps my child, or certainly my grandchild will be spared the difficulty of rote learning the data of a college education by a man-made, aptly named, wisdom tooth. Okay, if not a tooth, then a locket or a wrist computer.

Now I'm not seriously recommending that IBM should try to corner the market on dental supplies or that Intel should apply for FDA approval of its memories, but rather that the data processing community should become aware of the long range implications of size and price reduction of computing machinery. We are in the earliest stages of a technological revolution which will force us to reevaluate that human attribute, the storage, manipulation, and recall of information, and in consequence, the utility of an educational process that provides that information in a most inefficient way. ■

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The Electronic Product Associates Micro-68, a small computer costing about \$500. It also needs software to actually do anything. (Courtesy of Electronic Product Associates, San Diego CA)



The IBM 370/168 a large general-purpose computer costing several million dollars. With the proper software, this computer can handle many large tasks. (Courtesy IBM)

Talk Your Computer's Language!

... which level do you need ?

Lance A. Leventhal
PO Box 1258
Rancho Santa Fe CA 92067

It is hard to explain to people that a computer cannot do anything without a program or *software*. Even if the computer costs several million dollars like an IBM 370/168 it still won't do anything all by itself. Surely you cannot expect more from a computer like the Electronic Product Associates Micro-68, that costs only \$500. Even the spinning tape reels that represent com-

puters in so many movies cost more than that.

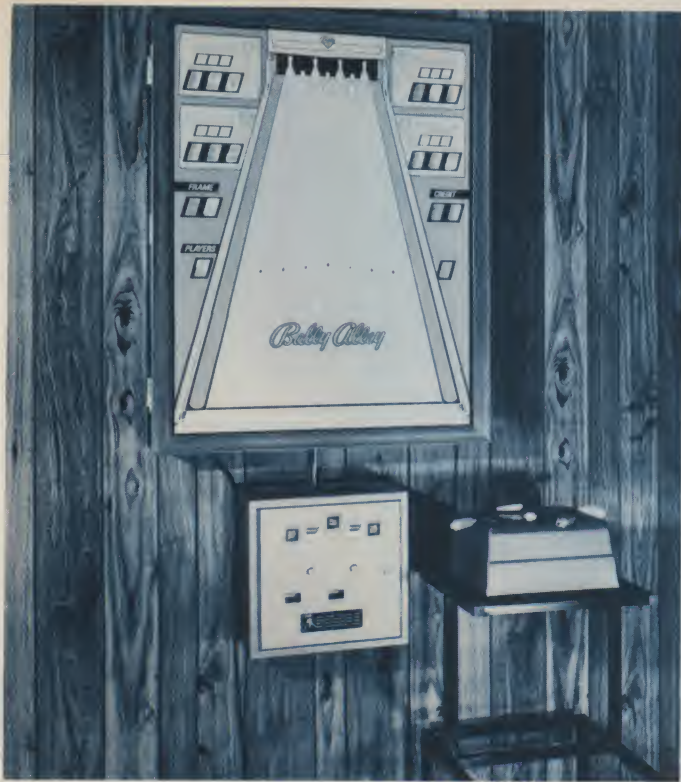
The Software Problem

But how do you write this mysterious program and what does it say? Newcomers to the computer field are often surprised to find that software is the major problem and expense in most systems. How do you write software? How do you get it to run properly? How can you be sure that it really works? These questions are far from solved. After all, programs and programming have only been around for thirty years;

we haven't solved many of the problems in disciplines like economics, literature, and history which people have struggled with for thousands of years. But would most people guess that the software involved in an application like the Bally Alley bowling game in the photograph cost thousands of dollars and many months to develop?

In order to use the computer, we must somehow translate the task we want the computer to perform into a series of instructions which it can understand. The com-

puter itself can perform some of the repetitive aspects of the translation if it has programs written for that purpose. We call programs which help us write and run the useful programs *systems software*; the useful programs are *applications software*. However, the more the computer does, the less control the programmer has and the more systems software, memory, and peripherals are necessary. The user must choose between the programming ease and power of high-level languages and the lower cost and greater efficiency of



The Bally Alley Bowling Game, a computer-controlled pinball machine. Software is the major problem and expense in such systems. (Courtesy of Bally Manufacturing Co.)

machine or assembly language.

Talking the Computer's Language

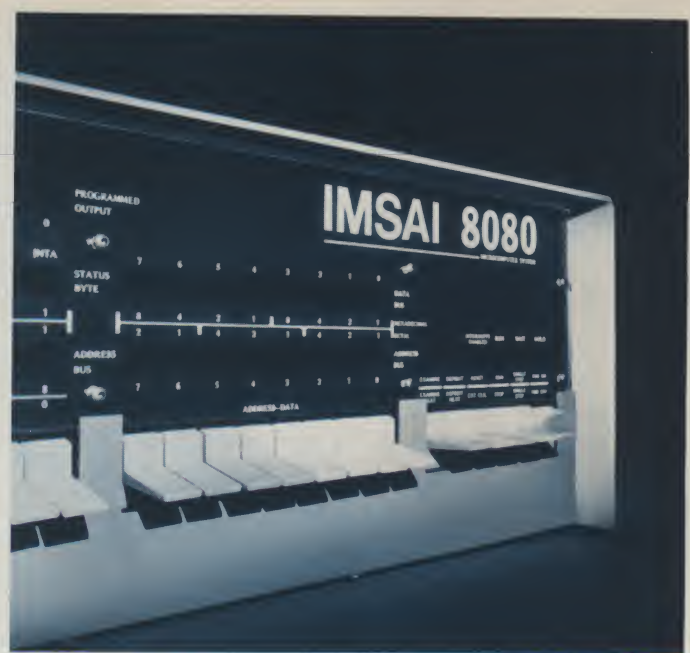
The computer itself only performs certain specified actions in response to the binary patterns which form its instruction set; the manufacturer defines this set as part of the design of the CPU. The instructions generally are rather simple: Add the contents of two registers or shift the contents of a register one place to the left. On the other hand, the tasks the programmer wants to do are much more complex: change a word in a line of text, read data from a cassette, or move a spaceship in a "Space-war" game. These tasks will require many of the simple computer instructions.

The programmer can try to do the entire job without any help from the computer. Of course, this was the original programming method; it involves writing the required sequence of instruc-

tions in binary and entering it into the computer memory with switches like the front panel switches on the Imsai 8080 in the photograph. An Intel 8080 program to add two numbers (locations 40 and 41 hexadecimal) and return the result to memory location 42 (hex) would look like this in binary:

```
00111010
01000000
00000000
01000111
00111010
01000001
00000000
10000000
00110010
01000010
00000000
```

Clearly the purpose of such a program is far from obvious to the reader. Furthermore, the entry process is tiresome and most people make a lot of mistakes. Only a person with a perfect memory and strong fingers could enter a long program this way. Of course, the



The IMSAI 8080 Computer. Its panel switches and lights can be used to enter programs in binary. (Courtesy of IMS Manufacturing Co., San Leandro CA)

programmer must also verify the entry procedure and somehow find any errors.

Finding errors is difficult since all binary numbers look the same (at least to this observer). Here is the same program as before with one bit wrong. Can you find the mistake? How long did it take?

```
00111010
01000000
00000000
01000111
00111010
00100001
00000000
10000000
00110010
01000010
00000000
```

Getting the Computer to Help

A simple way in which the computer can help is with an octal or hexadecimal monitor. This is a program which takes entries in octal or hexadecimal and converts them into binary. Now the simple addition program is (in hexadecimal):

```
3A
40
00
```

```
47
3A
41
00
80
32
42
00
```

At the very least, entering a program in octal or hexadecimal is easier on the eyes and the fingers. Furthermore, finding errors is much simpler. Here's the erroneous program in hexadecimal. Now can you find the mistake?

```
3A
40
00
47
3A
21
00
80
32
42
00
```

However, you must either buy or write the monitor program which does the conversion. Of course, such simple programs are widely available at very low cost. The conversion is a perfect task for a computer which never makes an arithmetic

mistake, looks at the wrong line, forgets to use the right number system, or gets tired of the whole procedure.

Note that the octal or hexadecimal monitor also requires more complex input and output devices. You will need something that will accept and display the octal or hexadecimal entries like the National SC/MP keyboard kit shown in the photograph. Even a simple device like this keyboard kit is more expensive than a row of switches and a row of lights (that's all you need for binary entry). Each added convenience results in extra costs in memory, programs, peripherals, and other accessories. It is like those bargain car prices they advertise on television; of course, that price does not include "dealer preparation, delivery, tax, license, motor, wheels, seats, doors, etc."

Entering instruction codes directly with no other assistance than that provided by a simple monitor is *machine language programming*. Its advantages are that you can enter programs directly into the computer and that you need very little extra software or memory. Its disadvantages are slowness, inflexibility, lack of documentation or debugging facilities, and complete machine dependence. The same addition program written for a Motorola 6800-based computer like the EPA Micro-68 would be (in hexadecimal):

96
40
9B
41
97
42

Clearly, the programs do not look much alike and neither one tells you very much about what is going on.

Machine language programmers must be very familiar with every aspect of the computers they use. The programmer must know what registers are available and how they can be used, what



The National Semiconductor SC/MP Keyboard Kit. Its keys and displays allow the user to enter programs in hexadecimal. The cost is \$95. (Courtesy of National Semiconductor)

effects the instructions have on registers and status flags, what addresses or data each instruction requires, and what limitations the computer has on addressing methods or data length. An Intel 8080 programmer must, for example, remember that the processor cannot add the contents of a memory location directly to the accumulator; you have to move the data to a register. A machine language programmer using either the Intel 8080 or Motorola 6800 must remember whether a particular instruction requires one, two, or three bytes of memory. Most computer users really are not very interested in such distinctions. They want to try a new game, play music, control an amateur radio station, or handle accounts. Few users want to spend their time becoming experts in manipulating registers and status flags. To most, this is not a very interesting or useful pastime.

Calling Things by Name

The programmer can improve the situation a little by assigning names to instructions, addresses, and data. This procedure makes programs more comprehensible and easier to debug but the programmer must keep the track of all the names and

eventually translate them into their binary or hexadecimal equivalents. The manufacturer provides a set of names for the instructions and the registers. These names are called *mnemonics* since they are supposed to be easy to remember. The problem is that while some operations have obvious mnemonics (e.g., ADD, SUB, JUMP, OR), others do not. The result is mnemonics like WMP, PCHL, and even SOB (try to guess what that means!) The programmer must assign names to addresses and data and will soon discover why the manufacturer has difficulty providing sensible names.

The Intel 8080 addition program using appropriate names is:

```
LDA NUM1
MOV B, A
LDA NUM2
ADD B
STA RESLT
```

This surely makes a little more sense than the binary or hexadecimal versions. The reader can differentiate between instructions, data, and addresses and get some idea of what the program is doing. Of course, the programmer must still translate the program into the form which the computer under-

stands. Remember that only the programmer gains from this change; the computer actually likes (and will only ultimately execute) the binary form.

This improved form using names is *assembly language programming* and the translation process is an *assembly*. Here again, the computer can help; the assembly is another repetitive series of operations which form an ideal task for a computer. The program which does this job is an *assembler*. It takes the assembly language program (*source code*) and produces a machine language program (*object code*). It translates mnemonics into binary codes, keeps tables of user-assigned names, and can do a lot of additional housekeeping as well. Note that the assembler does not care whether the names mean anything or not; it will handle WMP or SOB just as well as ADD, LOAD, or AND. Of course, an assembler is a much more complex program than a hexadecimal monitor.

The advantages of assembly language programming are obvious: Programs are easier to write, understand, enter into the computer, and debug. The programs are still different for each computer but not as different as in the machine language case. The Motorola 6800 version of the addition program, for example, is:

```
LDA NUM1
ADDA NUM2
STAA RESLT
```

The assembly language programs are certainly far more alike than the machine language programs. The assembler also will automatically make each instruction the proper length and immediately inform the programmer of errors in syntax. Some assemblers can create programs which the user can place anywhere in memory; they may also perform various code conversions, permit simple entry

of tables and messages, provide shorthand forms for common instruction sequences, and even do some arithmetic. As usual, the more the assembler does, the more it costs and the more memory it requires.

The most obvious disadvantage of assembly language programming is the need for an assembler. Not only do assemblers cost money (hand assembly is impossible for anything but short programs), but they also require extra memory and peripherals. A typical assembler will occupy several thousand words of memory; a printer is necessary to make listings and a cassette or paper tape reader to enter user programs and the assembler itself. Now you will find you need a peripheral like the \$1,000 standard teletypewriter shown in the photograph; it combines a typewriter-like keyboard with a paper tape reader and punch. Furthermore, the assembler has its own rules which the programmer must learn and error messages which the programmer must decipher.

The assembly language programmer still has the problem of describing a task in the computer's language, i.e., in terms of the basic instruction set. Complex operations will still result in many simple instructions. The programmer must learn and remember all the peculiarities of a particular computer. The final program will be difficult to understand without a great deal of documentation and unusable on any other computer.

Making the Computer Talk Your Language

Of course, the ideal procedure would be for the computer to understand an ordinary written description of the task. But human languages are far too complex for computers. The meaning of words is imprecise and often depends on their context or on the origin or

occupation of the writer. Computer translations of natural languages are seldom successful for this reason. The problem is to find a compromise which both the user and the computer can understand.

The *high-level (procedure-oriented) language* is a solution to this problem. High-level languages are designed so that a particular type of operation can be easily formulated and performed by a computer. A program called a *compiler* translates the high-level language program into an actual machine language program. Unlike assembly language, each statement in a high-level language will result in many machine language instructions.

A recent roster of high-level programming languages, although limited to those in more than local use in the United States, contains 167 entries. This roster does not include many new languages

developed specifically for small computers. Some of the high-level languages are general-purpose; others are specifically intended for such applications as engineering design, numerically controlled machine tools, transportation networks, simulation, graphs, animation, computer-aided instruction, systems software, string handling, test generation, economics, and circuit design. Among the ones you may have heard of (in alphabetical order) are:

1. ALGOL (Algorithmic Language). A general-purpose language which is popular with theoreticians. Also widely used in Europe.

2. APL (A Programming Language). A powerful language with an unusual character set which can operate directly on entire string and arrays.

3. BASIC (Beginner's All-Purpose Symbolic Instruction Code). A simple language developed for solving

numerical problems. Widely used for instructional, business and entertainment programs in professional and hobbyist applications.

4. COBOL (Common Business Oriented Language). An English-like language widely used in business data processing.

5. FORTRAN (Formula Translation language). A language originally designed for scientific applications, but now used in almost every field. The first and most widely used high-level language.

6. LISP (List Processing). A list processing language.

7. PASCAL. An extended version of ALGOL designed for structured programming and systems software.

8. PL/I (Programming Language I). A general-purpose language which combines many of the features of ALGOL, COBOL, and FORTRAN.

9. SNOBOL. A string processing language.

The existence of so many high-level languages clearly means that no single one has proved to be suitable for all tasks. Even more languages have appeared and disappeared. Fig. 1 tracks the rough history of the major languages starting with the development of FORTRAN in the early 1950s.

Of course, only a few of the languages are really in everyday use. The most common are FORTRAN for scientific problems, COBOL for business problems, and BASIC for instructional systems. Programs in *high-level* languages are much shorter and simpler than programs in assembly or machine language. For example, the addition program in FORTRAN becomes the single statement

RESULT = NUM1 + NUM2

Surely that program is easier to write and to understand than any of the previous forms.



The Teletype Corporation ASR-33 teletypewriter. This widely used device allows the user to enter assembly language programs from the keyboard or paper tape reader. The cost is around \$1,000. (Courtesy of Teletype Corporation)

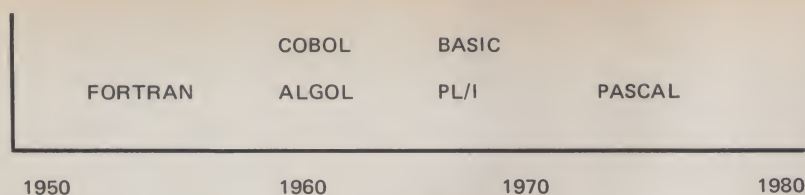


Fig. 1. A time history of common computer languages. FORTRAN is both the oldest and most widely used of these common high-level languages. PASCAL is a relative newcomer which computer users should be aware of.

Talking at a High Level

The high-level language program closely resembles the steps which a person in a particular field would normally use to describe the solution to a problem. The program does not mention the registers, flags, and addresses which the compiler will use to implement the statements. Users can formulate solutions in their own terms and let the compiler handle the details. A FORTRAN program, for example, is very similar to the algebraic formulation of a scientific or engineering problem while a COBOL program handles the large data files and complex reporting procedures that are typical of business problems. The designer must choose the proper language — COBOL would clearly be awkward for solving mathematical equations while a special language for complex equations would not handle a payroll very well.

The advantages of high-level languages are that programs are shorter, easier to write and debug, and more comprehensible. Furthermore, the programmer does not have to worry about (or learn) the internal workings or the instruction set of a particular computer. The resulting programs are portable (they can run on any computer that has a compiler for the language). In the case of common languages that have widely agreed-upon standards, the programmer may even be able to find old programs that solve a partic-



The Cromemco Z-2 Computer, a system capable of handling high-level languages if you add enough memory and peripherals. (Courtesy of Cromemco, Inc., Mountain View CA)

ular problem. There are lots of FORTRAN, COBOL, and BASIC programs in files, libraries, and magazines.

The disadvantages of high-level languages are that they often produce programs that run slowly and use a lot of memory. Most high-level languages are only suited to particular applications and all require a compiler. The compiler is like a real language translator; its awkwardness and inefficiency have the same causes as the strange translations one often finds from Japanese or German. The compiler itself occupies a large amount of memory and may be fairly expensive. Most computers capable of supporting high-level languages will be large systems with many extras like the Cromemco Z-2 system

shown in the photograph.

High-level languages also allow many tradeoffs. Some compilers can produce faster and shorter machine language programs by examining the context in which statements appear. However, these so-called optimizing compilers use more memory and run slower than regular compilers. Some languages are simpler and easier to learn but may not be suitable for complex applications. Sometimes a high-level language is not translated into a machine language program and then run; instead, a program called an interpreter simply translates each statement and executes it. This procedure uses less memory and can easily be made interactive but does not result in efficient programs and means that the

translation must be performed every time the user runs the original program.

Choosing a Level

Which way is the best? The choice depends on the programmer and the task. High-level languages are easier to use and provide more comprehensible programs. Assembly and machine language allow the programmer to manipulate the computer very cleverly; this often results in much faster and shorter programs. BASIC, for example, is well-suited to games, editors, calculators, interactive programs, and instructional uses. Assembly language is often better for I/O handlers, operating systems, real-time applications, and other systems programs. Even if you do not normally write assembly language programs, you may want to learn a little about assembly language. That way you will know how it works and you will be able to take advantage of other people's assembly language programs. But high-level languages are clearly the way to go for most large user programs; writing, debugging, and testing the programs are all much simpler. ■

References.

- Eckhouse, R., *Minicomputer Systems*, Prentice-Hall, Englewood Cliffs, N.J., 1974.
- Hemmye, J., "The Fun of Learning BASIC," *Kilobaud*, March 1977, pp. 120-122.
- Kemeny, J.G. & T.E. Kurtz, *Basic Programming* Wiley, New York, 1971.
- McCracken, D.D., *A Guide to FORTRAN IV Programming*, Wiley, New York, 1965.
- McCracken, D.D. and U. Garbassi, *A Guide to COBOL Programming*, Wiley, New York, 1970.
- Molnar, J., "Practical Microcomputer Programming. Part 3: Software Tools," *Kilobaud*, March 1977, pp. 18-22.
- Sammet, J.E., "Roster of Programming Languages for 1974-75," *Communications of the ACM*, December 1976, pp. 655-669.
- Stark, P.A., "Why So Many Computer Languages?," *Kilobaud*, February 1977, pp. 26-32.



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A PET For Every Home

... a look at the Commodore PET 2001

Sheila Clarke
P.O. Box 430
Glendale CA 91206

As far back as two years ago it was predicted by a few that someone would produce a computer system, designed to sit alongside your calculator, or TV and stereo. Commodore Business Machines of Palo Alto, California has done just that. They're aiming the PET 2001 at every housewife, small business person, and kid on the block. The PET (Personal Electronic Transactor), Commodore claims, is the first mass-produced turnkey computer to be manufactured, that can be used by anyone from six-year-olds to fine instrument design engineers. The term "home computing" is now being redefined by Commodore to include consumers beyond the range of heretofore hobbyists.

There is certainly not enough time for any author or magazine to check out every single new computer that pops up on the horizon. But two things sent us up to Palo Alto for a first-hand look. One was the low price (how can they do that?!) and the other was the mass market appeal (what would I do with a computer, anyway?).

Ready to run at the flip of a switch, the PET 2001 will be priced in the \$600 range. The complete system integrates a 9 inch video display, ASCII and numeric key-

boards on one panel, cassette storage and BASIC software. The 6502 based machine has been given a specially designed interface based on the IEEE-488 bus standard. Resident memory totals 12K. Details on the PET specifications and software are discussed further on, but first let's take a look at Commodore's thinking with regard to PET's future.

Arnold Karush, Systems Sales Manager for Commodore, has been a programmer by trade. Formerly marketing manager at Imsai, Arnie moved over to Commodore in early April to handle the newly formed division for the PET. Chuck Peddle, designer of PET, hailed from MOS Technology (KIM manufacturers) where he had designed the 6502 chip. Both gentlemen responded to the question regarding the low pricing of PET by explaining that Commodore is a "vertically integrated company," meaning they now own MOS Technology which makes the most expensive ingredients at rock bottom pricing. Some of those ingredients include semiconductors and the 6502 chip. What Commodore can't produce, they can afford to purchase in large quantities wherever in the world the components are least expensive. Says Arnie Karush, "Commodore manufactures all the most costly components itself. Also it is taking a mass production view. No one, not even IBM has yet

mass-produced a computer. The pricing is structured to promote sufficient profits, and at the same time, produce sufficient sales to support the product at this low price. We could sell it for \$1,000 and still sell a lot."

Chuck Peddle explains further, "We feel prices can be controlled. The most anti-inflationary thing going is semiconductor technology. Commodore purchased that capability when they bought MOS Technology. We decided the best utilization of their capability was with our known retail service and an international manufacturing and marketing viewpoint. They (MOS Technology) felt the best place to put their money was in personal computing in a way that would let them maximize their semiconductor orientation."

Specifications

The entire unit weighs forty-four pounds and measures 16½" wide by 18½" deep and 14" high. Memory includes an 8K BASIC interpreter and a 4K operating system, with optional possibilities for expansion to 32K. The video display has unusually good resolution in a 9" screen. It features a 1000 character display in 40 columns by 25 lines. The 8 x 8 dot matrix makes for fine continuous graphics and graph plotting, as well as automatic scrolling and blinking cursor. Graphics capability also includes

reverse field on all characters.

The keyboard has 64 ASCII upper and lower case characters scrunched into a smaller area than a normal keyboard, but arranged identically to a typewriter. The upper case characters provide the pseudo-graphics capability, including playing card symbols. Alongside is the numerical keyboard arranged calculator style. Limited editing functions provide insertion and deletion, with screen control of clear and erase.

The cassette drive uses standard cassette tapes. Commodore is providing a file management system in BASIC. Some of the programming capabilities include single character input/output with a GET command, strings, integers and multiple dimension arrays. The PEEK and POKE commands permit one to program in assembly language using subroutines. Commodore feels their BASIC expands the capabilities of current BASICs by claiming it's 20% faster, and uses high precision with ten significant digits.

Peripherals

The IEEE-488 interface standard has several important implications. Among them is the high quality of communication capable between the PET and peripherals. No, there are no peripherals yet available for the computer. But Commodore projects that the first of



Commodore Business Machines' PET (Personal Electronic Transactor) Computer.

several will be available within the next six to nine months. It will be a printer with formatting capabilities, followed by an intelligent floppy disk system. All peripherals will connect to the bus in daisy-chain fashion. Each will be individually addressable. Pricing for peripherals is anticipated to be as relatively low as the PET is to competitive micros.

Now, all you home-brew entrepreneurs stop tugging on your earlobes and pay attention: Commodore is inviting outside designs of special features and functions to be submitted for purchase and inclusion in the PET package. Your invention must be more than theory and hypotheses ... it must be proven. The company is, however, very interested in encouraging outside innovation and invites you to submit yours directly to Commodore, PET Division, 901 California Ave.,

Palo Alto CA 94304.

Chuck Peddle talked about the design possibilities for future peripherals, saying, "We've done some things in the PET that are not obvious. The cassette, though a standard audio drive, has been dramatically simplified. Commodore designed all its electronics. We look at a mechanism or a peripheral and try to figure out how to put smarts into it. For instance, the floppy disk will probably have three processors. We'll be using micros to handle a lot that other manufacturers do not."

IEEE-488 Bus Standard

The PET departs from the so-called Altair bus standard by using the IEEE-488 bus. Until now, as it was explained, the only way to obtain interfacing for this bus was through very few manufacturers, like Hewlett/Packard, and at great ex-

pense. Arrival of the PET particularly excited instrumentation houses across the country, according to Karush, because most of them require the IEEE bus to computerize their instruments. "Several years ago instrumentation houses predicted that ultimately all instruments would be connected to computers. Very expensively." So, he continued, designers got together and under the IEEE banner, developed the IEEE-488 standard interface. It has been published and is now accepted by all instrumentation houses. Most have the capability, but in a black box only. Until now, no one has offered a computer using this standard.

Software

The mass consumer market is not made up of programmers. So heavy emphasis has been placed on development of a wide

variety of software packages. Many programs, several on one cassette, will be available at the time the PET goes on the market. Some include financial management, home accounting, real estate, and games (of course!). About 40 volumes, or cassettes of programs are anticipated to be available in September.

Now you software types pay special attention. Commodore is going into the software publishing business. Authors will now have a market for their 6502 software because Commodore is particularly interested in stimulating a market for your talents. Software writers who have fully debugged, tested and documented programs for the PET may submit them to Commodore for purchase or royalty payment. Anyone interested in participating may contact Ms. Terry Brock at Commodore in Palo Alto. Arnie Karush added that if



Chuck Peddle, Pet's designer at Commodore, and 6502 chip designer while at MOS Technology, plans to put "smarts" into every peripheral to be designed for the PET.



Arnold Karush, Commodore's Systems Sales Manager, predicts spectacular first year sales for PET. He confidently speculates that Commodore's mass-produced computer will take the world's population by storm.

Commodore sees that programmers are clamoring for assembly language, they'll develop it.

Who Will Buy a PET?

Can't you see it now: "Every Man Who's His Own Man Owns a Personal Computer" headlined in a *Playboy* Magazine ad. It's coming. Sure, you can order a PET directly from Commodore. More conveniently, you should be able to walk into your nearest computer store and buy one off the shelf. But wouldn't it be a knockout to see it on the shelf of a large department store? That's coming too. At this writing Commodore was still negotiating with a specific retailer, but by now you can check out the advertising in your local newspaper or computer magazine, or perhaps walk into a nearby Sears or Montgomery Ward and see it on the shelf in the business machines department. Karush speculates, "We've concentrated our marketing target on women, but it really applies to men too. If we put an ad in *Playboy* Magazine for instance, or *Newsweek*, or

Business Week showing a personal computer . . ."

Recent experience with non-hobbyist reaction to seeing a computer in our homes has been of puzzlement and dismay, even awe. When asked how Commodore expects to overcome public resistance to the negative image of computers, Chuck Peddle expressed a sureness that when housewives and working mothers see how simplified their lives, and challenged their minds can become with the addition of a computer, how can they resist?

As Karush puts it, "So far most computer purchasers have been 99% male. If the average man wants to spend \$600 for a computer, he's going to have to justify the expense to his wife. So we've taken a look at how a computer may serve that segment (women) of the population. Bridge, for instance, is a complex game that can be brushed up on with the computer before playing with friends (and making a fool of yourself). Or some who have a good educational background and have

become bored watching soap operas, have an opportunity to learn something new and challenging. Like programming." Other obvious applications are checkbook and tax record keeping, or menu planning.

Small businesses can use the PET when the printer becomes available. Kids can play games, then when sufficiently hooked, can learn to program. Devices are expected to be available to help the PET handle such functions in the home as energy conservation, control of appliances, and security systems control.

The PET is not yet optimized for broad business applications. But it can now aid, say, an orthodontist in computing the angles for putting braces on someone's teeth, or compute three-dimensional geometry if you're a bridge (not dental) designer. You could compute stress analysis and do bar graphics. Now. It's a great way to get a \$600 computer to do what it's taken a \$3,000 computer to do.

But can it all be done when the PET is available in

September? No, unless the software volumes are purchased separately, provided they've been developed by that time. Some will definitely be available. Projections are that a single cassette package will come with the PET, containing tutorial programs. Additional volumes can probably be purchased for around \$10 to \$20.

What About Hobbyists?

Karush believes that many hobbyists do not have a CRT, or a good BASIC, or a way to load BASIC. If they do, they don't have a good way to get it up and running. Or they don't have graphics capability. In any event Commodore is not concerned with trying to replace 20,000 or so existing home computers. "If we didn't replace any of these, we'd hardly notice it in terms of the overall numbers."

Commodore is betting that their PET will be the forerunner of a whole family of computers. Nobody has yet proven that you can sell 100,000 computers in a year. Commodore will be the first to try. ■

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If you're into games try out the Star Trek and see how good it is. If you want to go into business printing out statements for local businesses, see what kind of a job the systems will do with that. The people who have designed and built the systems will be there so you can ask them questions ... and many of them will be putting on illustrated talks about their systems.

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You may need it.

PUBLISHER'S REMARKS

from page 21

is a very bad time to vacation. The Cape, New Hampshire and Maine all fill right up that weekend. You'll do well to avoid travelling on weekends. Right after COMPUTERMANIA will be ideal, for the weather is still fine and most people have finished their vacations by then.

If you're wandering around southern New Hampshire you might pay a visit to *Kilobaud* — we're easy to find. Turn off Route 93 and go south on Route 128 on the outskirts of Boston. From there you turn north on Route 3 toward Nashua, New Hampshire. If you are even slightly hungry, you'll get off at the first exit, Route 62, and go east for about one mile where you'll see Betty Crocker's Pie Shop on the corner. You won't find more delicious pies anywhere. The food is just average, but the pies are fantastic — I never miss a chance to "pie up" when I'm in the vicinity.

After pie, head back north on Route 3 and exit in New Hampshire at exit 7W. This is Route 101A West. About two miles into this route you'll see the Microcomputer Store on your right — next to Santoro's Pizza. If it's open, stop and say hello to Steve and Dexter — you'll not find two nicer guys. Buy something.

Route 101A turns into 101 as you round the bandstand in the center of Milford. Keep going west. As you come down a long straight stretch into Peterborough the second cross street is Pine Street (on the right ... Powers Bridge Road on the left). Turn right on Pine Street and then into the first driveway on your right — says Wayne Green. We'll be expecting you. You won't believe what you're going to see here. It's a mammoth house

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(over 200 years old) filled with people running all over the place ... setting type ... pasting up articles ... proofreading ... etc.

NEW PRODUCTS

from page 10

California speech research firm.

Known as SpeechLab, the system is available in selected computer stores and directly from the manufacturer for \$249 in kit form or \$299 assembled and tested.

SpeechLab digitizes and extracts data from a speech waveform and applies pattern matching techniques to recognize the vocal input. Uses include computer input, games, research and vocal control.

In addition to Altair bus computers such as Sol, Altair, and Imsai, Speechlab can be used with any computer with the aid of a separate power supply and connector.

Included in the price is a complete hardware/software system, a 275 page laboratory manual, 95 page hard-

ware manual, high fidelity microphone, and three programs on paper tape. The lab manual is the only introductory volume on speech recognition currently available, according to the manufacturer.

The lab manual includes 35 graded experiments with over 100 tables and graphs. According to the manufacturer, the system can put the user in a position second only to Bell Laboratories with respect to knowledge and use of speech related to computer input.

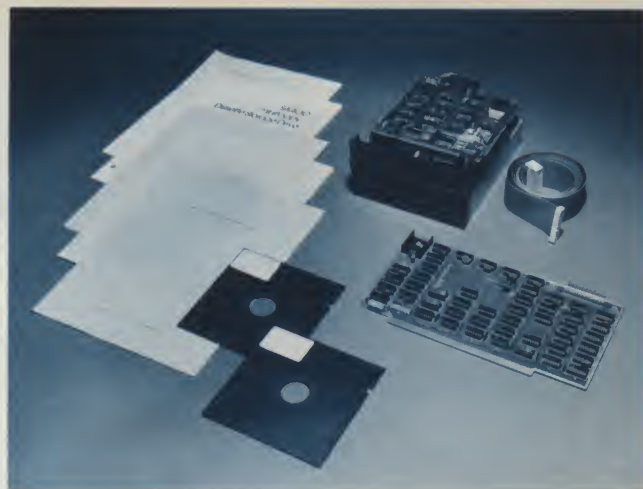
Technically the system features 64 bytes of storage per spoken word and a vocabulary of up to 64 words in memory. Other features include real time response, 95% correct recognition, automatic hardware self-test capability and advanced C-MOS design for low power and reliability.

Software includes SpeechBasic BASIC programming language, assembly language speech recognition program, SpeechBasic plot, correlation, recognition, advanced recognition and hardware self-test programs.

For complete information, address Heuristics, Inc., 900 N. San Antonio Road, Los Altos CA 94022.



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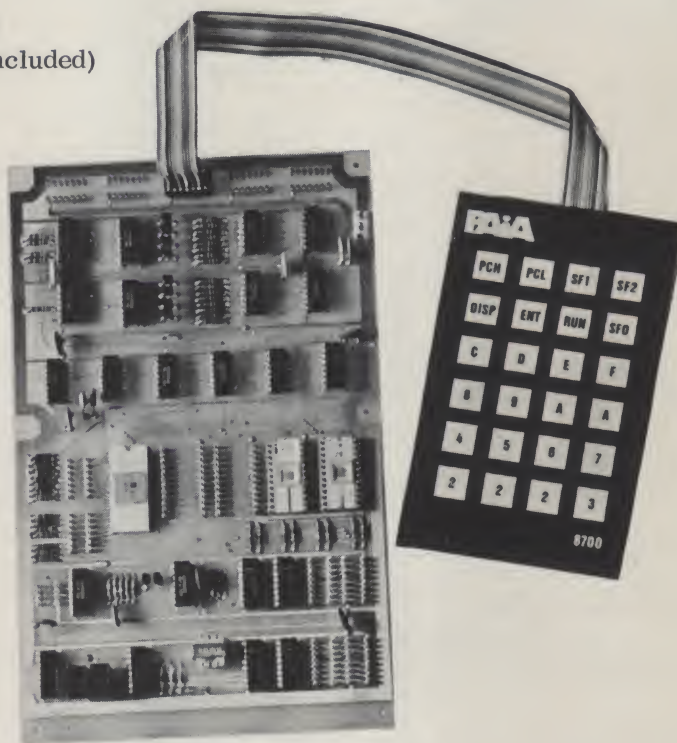
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KILOBAUD KCLASSROOM NO. 4



PC boards and power supplies

George Young
Sierra High School
Tollhouse, CA 93667

During the last session we investigated number systems, the seven segment decoder, an LED register, and our first linear circuit chip, the 555 timer.

Now we're ready to tackle PC boards, power supplies and voltage regulation. The PC board technique used will be the least expensive, fastest method I've found, and is suitable for one-board-at-a-time construction. We're going to design a PC board for the clock circuit in the student console (which will complete construction of the console). Power supplies could very easily be the subject of an entire article. The same thing applies to the subject of regulation.

PC Boards

The term *printed circuit board* is a misnomer. Printing is an additive process. If I read the current literature correctly, we will soon have PC boards made by actually printing the circuit patterns on an insulating board. But right now, we are going to be talking about *etched* circuit boards, and etching is a subtractive process. The name PC board has been with us for a long time, and we are not going to fight it. We will also call our boards PC boards, even though we will use the etching process. Our end result should look like the PC board in Photo 1.

Certain materials and terms are common to every

method used to make PC boards. A thin sheet of copper is bonded to some kind of insulating board with an adhesive. The copper clad board that I used for my first circuit board was made by cementing a thin sheet of copper foil to a piece of plastic laminate. You could also make copper clad board this way, but today it is just as economical to buy the finished product, and it's quite a bit better.

The second common factor in PC board construction is called *resist*. Resist is any material that will resist the action of the etching solution. Many things can be used for the resist. What you need is something cheap,

effective, and easy to apply.

The third common factor is the etch, and again, there are different materials that can be used. Ferric chloride solution is the one we will use. A container, which I call a boat, must be used for the actual etching process. The boat should be made of glass or plastic. Metal containers must not be used.

Finally, a small diameter drill is needed to drill holes in the etched circuit board to allow parts and chips to be inserted (stuffed) and then soldered.

The five things just listed are necessary for any method of PC board construction. There are a lot more things that make the job faster, easier or better, but the five just described are essential to any method used.

I am going to teach you how to make a PC board by describing the steps here, which is not going to be easy or particularly efficient. It will take longer to write out and to read all the steps than it will take to do them. Do each step in sequence.

Laying Out The PC Pattern

Use a sheet of graph paper ruled 10 lines to the inch. This is the easy way to do the layout. If you don't have this type of graph paper, read on; we can still get the job done.

On the upper half of the sheet make a copy of the circuit diagram that you are going to lay out. The graph paper helps by giving you a rectangular grid to make neater circuit diagrams. Having the diagram immediately in front of you helps prevent errors in layout. Every time you copy a circuit diagram, a little bit of the electronics gets stored in your brain. The more circuit diagrams you draw, the faster you learn the electronics. If you are not using graph paper, the circuit diagram still goes on the upper half of the sheet. The circuit that we are going to lay out is given in Fig. 1.

Place the 555 chip on the lower half of the paper, and locate the positions of all eight pins on the graph paper. The grid line intersections make this step reasonably

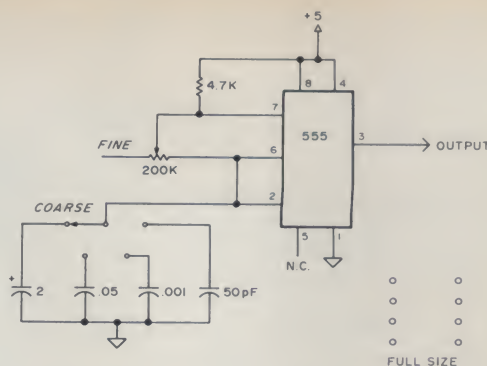


Fig. 1. Console clock circuit and 555 timer pin layout.

simple. If you do not have the graph paper, then we must use an alternate approach.

I suggested a technique in an earlier class session which I will repeat here. Place a sheet of scratch paper over the hole pattern on the Superstrip. Lightly shade the paper with a pencil until you can see the pattern. Remove the Superstrip and place the shaded paper on a newspaper or old magazine. Circle the hole positions that correspond to the eight pins of the 555 with a pencil. Make a plastic template by punching through paper, plastic, and magazine using the scribe we made in class session 1 (May issue). Using this template, punch 8 holes in the sheet of paper to locate the pin positions for the 555 chip. At this point, your layout should look like Fig. 1.

Identify the positions of pin 1 on the 8-hole pattern. This step is so important that we have deliberately positioned it in the most unlikely position of all for layout. We have even indicated the position of pin 1 in Fig. 2a with a little flag. We emphasize here that the pin positions get reversed as you read the chip from the bottom, and Fig. 2 is a look at the bottom.

Now, using the circuit diagram above your layout area as a guide, put in a pad for the wire that will connect pin 1 to -. (See Fig. 2b.)

Move on to pin 2. Pin 2 connects to pin 6, so we put in a line from pin 2 to pin 6

(see Fig. 2c).

Pin 3 is the output and will have a wire going to the clock output bolt on the console front panel. So, in goes another pad for this wire (see Fig. 2d).

Pin 4. Oh, oh! We cannot connect directly from pin 4 to pin 8 and + since the trace from pin 2 to pin 6 blocks our path. We could go out and around pins 3, 2 and 1 and over to pin 8, or we could go out and around the other side, but instead we will use the blockade to introduce the jumper. Put in a pad next to pin 4 and another pad next to pin 8. We will use a wire placed on the chip side (called the component side; the side of the board that we are working on is called the foil or trace side) to get pins 4 and 8 connected. This wire is called a jumper. We have indicated this jumper wire as a dotted line in Fig. 2e.

Pin 5. This is the easy one. No connection.

Pin 6. Pin 6 goes to pin 2. We got that already. Pin 6 also goes to the speed control (clock fine adjust) and to the timing capacitor switch (clock coarse adjust). So two pads are needed for these two wires (see Fig. 2f).

Pin 7. Pin 7 has a 4700 Ohm resistor (4.7k) and a wire out to the speed control pot. The other end of the 4.7k resistor must end up on +. Lay the 4.7k resistor that you plan to use on the pattern layout. Put in two pads, one for each end of the resistor. We have oriented this resistor vertically as shown in



Photo 1. Etched and drilled console clock PC board.

Fig. 2g. We have also drawn in the resistor symbol on the pattern to show its location. If you also put this in with resist, make sure that the ends of the resistor symbol do not actually touch the pads. This will short out the resistor if the symbol actually connects the pads together.

Pin 8 goes to pin 4 and to +. We have already made provisions for connecting pin 4 to pin 8. Another pad is added to provide for the connection of pin 8 to +. The 4.7k resistor also goes to + on one end, so all of these points get tied together (see Fig. 2h).

This takes care of all the pins on the chip and all the pins on the circuit diagram. The next step is to double check everything and make certain that we did not miss anything. Here we are actually wiring up the circuit, so any errors now can be easily eliminated with a pencil eraser; errors discovered later are much more difficult to correct.

Now we are going to mount the timing capacitors on the PC board. We will add extra holes in the ground foil portion of the timing capacitor section so that capacitors of different lengths can be utilized without having to measure them ahead of time.

The last step is optional. We are going to run the ground foil all the way around the outside of the circuit pattern. This places the periphery of the circuit board at ground potential and simplifies the mounting of any circuit board. It also means that we have to etch away less copper, so the circuit will etch faster and we will get the board completed sooner. The final layout is shown in Fig. 2i.

Copper Clad Layout

Cut a piece of single-sided copper clad board to the size delineated by your layout. After you have cut it, polish it bright and shiny. Steel wool is the fastest method,

but you can scrub it with a tooth brush and cleanser, fine sandpaper, or even an eraser. After you have the copper surface bright and shiny, *do not touch it with your fingers*. Handle the cleaned board only by its edges. Your fingers will transfer body oil to the copper surface.

Copper loves this oil, and it will prevent the resist from adhering to the copper surface.

Hold the cleaned board

a pencil draw a small circle around each pin prick. Return the copper clad to the work surface. Using your layout as a guide, re-establish the circuit board pattern. If you make a mistake, erase it. Draw in the circuit board pattern in pencil. Double check before you start with the resist. Get everything right at this point.

Resists

What to use for the resist?

This is a petroleum product that will dissolve in water. It is a light brown color in solution and dries to a black, tarry substance in a few minutes. It makes an excellent and very inexpensive resist.

Bitumol in a water solution is the same stuff that county and state road maintenance crews spray on pavement prior to patching holes in it. A couple of grams of this stuff dissolved in

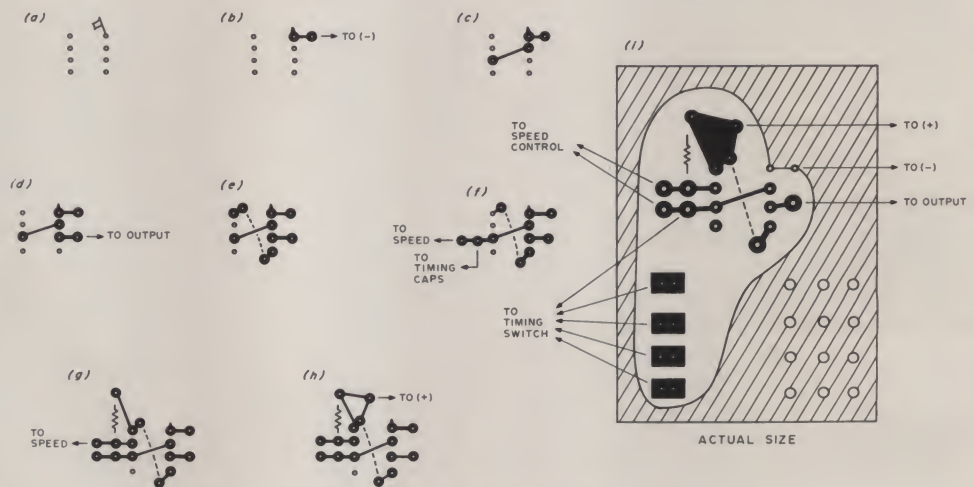


Fig. 2. PC board layout (bottom view).

and your layout up against a bright light with the board behind the paper. Position the copper clad board behind your layout. Return the pair to the work surface without allowing them to move. You can tape the two in position if you want to.

With the scribe (or any sharp-pointed tool) transfer the hole and pad locations to the copper surface. Easy does it. All we want is a very light pin prick in the surface, just enough to allow us to see the pad location. We do not want a center-punch type of indentation. Press the probe firmly against the copper surface and rotate it slightly. This will be just about right. Double check each hole location to make sure that you did not miss any pads. This is especially true for the IC pin locations.

Hold the copper clad up to the light so that the light reflects off the surface. With

A resist pen can be used, but I find it difficult to get the detail that I require. Speedball Extra Dense Drawing Fluid has been used successfully and can be applied with an ordinary pen point. Ordinary India inks have been tried, but most of them have come off in the etchant, and therefore are not recommended. Grumbacher Ink Concentrate has been used with success.

Some of the new dry transfer materials are made in resist form. They are used by rubbing off the pads from the transfer sheet onto the copper surface, then adding the traces and burnishing to seal the resist onto the copper surface. Masking tape, or plastic electrical tape can be used with varying degrees of success.

My favorite resist is a material called bitumol (pronounced bitch-mole).

water with 1 drop of household dishwashing liquid detergent will make enough resist to last you for years. It will probably be as easy for you to bum a small quantity from the state highway department as it will be to find a supplier who will sell you some. It is put up in 55 gallon drums, and I'm afraid that would be a bit more than you could use in a couple of lifetimes. Besides, my Scot's blood dictates that you should scrounge whenever possible. The bitumol is applied with an old-fashioned pen point for detail areas, and with a small paint brush for the larger areas.

Use whatever resist material you can get your hands on. Make the pads as large as you can without having them short circuit to an adjacent pad. Remember that we are going to drill each pad, and if the pad is too small there will be no copper

left to solder to. If adjacent pads short, allow the resist to dry, then scrape a line between the two pads with any sharp pointed instrument. If you make an error in applying the resist, allow it to dry. Then scrape off the error, and redo that portion of the circuit traces. Also, the more copper you can leave on the board, the less likely you are to have a trace or pad lift off the insulating substrate during the soldering operation.

Etching

Pour the etchant from its storage container into the boat. If you don't have a plastic or glass container that is suitable, then try this: Take a half-gallon milk carton, slice it lengthwise, retaining the sealed portion, and use it for the boat. It has the advantage of low cost and easy disposal, and will etch several circuit boards before it must be replaced.

Keep ferric chloride etchant off your clothes and hands. It will stain clothes permanently. It will eventually wear off your hands. If you inadvertently come in contact with the etchant, flush it off immediately with water. If you etch in the kitchen sink, your wife will probably allow you to sleep on the sofa. Ferric chloride will stain the sink, and it will require a great deal of energy on your part to clean it. Etch in an old sink or out in the back yard to keep peace in the household, and be sure to keep it off your clothes.

Hold the copper clad face down and almost touching the surface of the etchant. Then drop it in so that surface tension allows the copper clad board to float. Floating face down on the etchant allows the etching to take place without agitation. If the board sinks, then it will have to be retrieved from the bottom, turned face up, and agitated during the etching process. Retrieve it with a piece of scrap hookup wire, and turn it over with this

wire, not your fingers. With fresh etch, about 20 minutes at room temperature will do it. Use the scap wire for inspection of the board.

Heat can be used to speed the etching process. A heat lamp, or even an ordinary reflector flood lamp can be used. Place the lamp about 18 inches from the boat. If the milk carton boat is used, be careful not to melt the wax that makes this boat waterproof. Direct sunlight outside

used. Small blobs, or speckles can be removed with the pen knife or a small file.

Drill the board. A #60 drill is usually specified. Anything reasonably close will work. A drill press is nice, but an electric drill hand-held drill can be used. (Carbide PC drill bits are available for \$.50 each from: Cut-Rate Electronics, 1915 Tuolumne St. Fresno CA 93721. Better buy two; they break easily.)

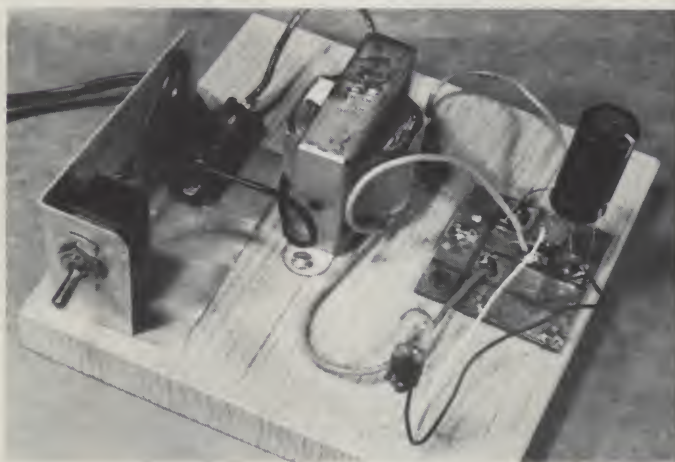


Photo 2. "Breadboard" unregulated supply.

will also speed up the etching process. The ferric chloride etching process appears to be a photosensitive reaction.

When the etching process is complete, allow the board to sink in the boat. Pour the etchant back into its container, and flush off the boat and board (still in the boat) with large amounts of water. Continue until no traces of orange or green liquid remain. Dry the board.

Finishing the Etched Board

Remove the resist. Bitumol comes off with any petroleum solvent. Dampen a rag and wipe off the resist. Other resists can be removed with steel wool. Polish the board bright and shiny again.

Carefully examine the board. If any traces are shorted, cut them apart with a sharp pen knife. If extensive surgery is indicated, a hacksaw blade removed from its frame and handheld can be

Polish the board again with steel wool and tin the large areas with solder. Do not tin the pads.

Stuff the board. The jumper(s) always go in first. Then the resistors, then the chip(s), and finally the larger components. The purpose of this sequence is to have the board lie as flat as possible during assembly. Therefore the larger, more bulky components go in last.

Function test the completed board. Plug the completed board into the Superstrip using the wires attached to the board. It is much easier to troubleshoot out front than it is behind the panel. When you are satisfied that the circuit board is operational, it can be installed behind the panel. This will complete the console front panel.

Substitutions

We promised in an earlier

class session to show you how to get around the requirement of the 4-pole single-throw switch. This is the coarse frequency control on the console panel, and switches in different values of capacitance to change the basic 555 clock frequency range. If you don't have this switch, here is a way around it.

Mount a transistor socket in the 3/8 hole for the switch. Connect only two wires to the circuit board, one to pin 6 and one to ground. Connect these two wires to two of the pins on the transistor socket. Now different values of capacitance can be plugged into the transistor socket to change the basic clock frequency range.

This is a nice little variable speed clock circuit that will run up to 100 kHz or a little beyond. It has sufficient drive to drive almost any IC that you might wish to clock. It has good frequency stability which can be slightly improved by bypassing pin 5 on the 555 to ground through a .01 disk capacitor.

Power Supplies

As mentioned in the preview, an entire article could easily be devoted to power supplies, and a second article could be devoted to voltage regulation. For now, we will only cover the pertinent details of power supplies leaving a detailed inquiry to another time.

Experiment #17 The Unregulated Power Supply

Purpose: a. To build a power supply for the console. b. To study the fundamentals of any power supply.

Equipment: 1) Line cord, fuse holder and fuse, 1/2 Amp, SPST toggle switch. 2) Power transformer; 120 V ac primary, 12.6 V ac @ 1 A secondary, centertapped. 3) Filter capacitor, 1000 uF (or more) at 15 V dc (or more). 4) A terminal strip or PC pad board for mounting components. 5) Two silicon

diodes, 1 Amp (or more) at 25 PIV (or more).

A dc voltmeter is desirable for testing the completed supply. However, if a voltmeter is not available, a pilot lamp can be substituted.

Symbols: Refer to Fig. 3 for the new symbols introduced for the power supply.

Circuit: Refer to Fig. 4 for the circuit diagram.

Procedure: Anchor the various components temporarily on a block of wood, about 15 cm x 15 cm. Haywire the components together as shown in Photo 2. Caution: 120 V ac is exposed and must be considered lethal. Do not work on the circuit while the line cord is plugged in. Always disconnect the line cord while working on any circuit. Do not touch anything while the line cord is plugged into the 120 V ac outlet.

After all connections have been completed, we will conduct a smoke test. This is exactly what it sounds like. We plug the power supply in, turn on the switch and look for smoke. If we get smoke, that's bad. Immediately pull the plug and start looking for the problem. If we don't get smoke, that's good, but it is no guarantee that things are working.

Check the output voltage with a dc voltmeter. Connect the + lead on the voltmeter to the + lead on the filter capacitor. Connect the - lead on the voltmeter directly to the - lead on the filter capacitor. Set the range switch on the voltmeter to 15 V dc (or more) and the function switch on the voltmeter to dc+. If the voltmeter probe has a switch on it, it should be placed in the dc position. The dc output voltage of our power supply should read about 9-10 V dc. If no voltmeter is available, a #44 or a #47 pilot lamp can be substituted.

First connect the pilot lamp across the 6.3 V ac

winding of the power transformer. This will be across center tap and *one* of the transformer wires going to a diode. Wires may be soldered directly to the bulb for this step, or the bulb can be mounted in a socket, and wires attached to the socket. The lamp will glow with a certain brilliance. Then connect the bulb to the power supply output (directly across + and - on the filter capacitor). The lamp

former or your house.

Alternating current enters the *primary* of a transformer where it is *transformed* either up or down in voltage, and either up or down in current. If the voltage goes down, the available current goes up. If the voltage is transformed up, the available current goes down.

This transformation of voltage and current in a transformer is accomplished by magnetic forces. A changing

or in a negative direction.

As one ac waveform goes in a positive direction, one of the diodes is forward biased, and conducts. Current flows from ground through the load (the circuit that is taking power from the power supply) through the diode that is conducting, through one half of the power transformer secondary and back to ground.

During the other ac cycle the other diode is switched into the circuit, conducts, and current flows through the load, through this diode, and through the other half of the transformer secondary back to ground. Since current is flowing in only one direction through the load, the diodes are changing the ac to dc. The process of changing ac to dc is called *rectification*, and the diodes are often called rectifiers. Since we have a circuit that is producing two pulses out for each 60 cycle pulse in, we have a frequency doubler circuit.

The filter capacitor charges up each time a diode delivers a current pulse to it. As the ac waveform falls, the filter capacitor feeds stored electrons back into the circuit, thus helping to smooth out the 120 cycle pulses. Any remaining 120 cycle pulses are called ripple.

Peak Inverse Voltage

Let us assume that you have a 120 V ac soldering iron (as opposed to an iron that is operated from a step down transformer) and that your soldering iron is plugged into 120 volts dc. The iron will reach a certain temperature. Now suppose you plug your soldering iron into 120 volts ac. The soldering iron will again reach the same temperature.

How is this possible? Part of the time the ac is zero, and at all times it is either rising or falling; it is never stationary. The 120 V ac value is called the Root Mean Square (RMS) value of the ac. It is the ac value that will provide the same heating value of a

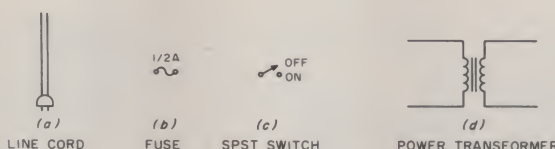


Fig. 3. New symbols introduced.

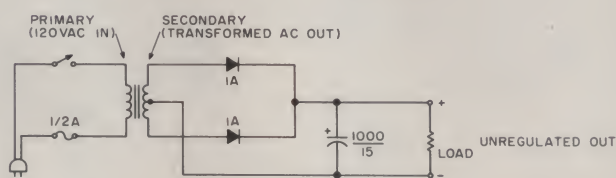


Fig. 4. Console unregulated power supply circuit.

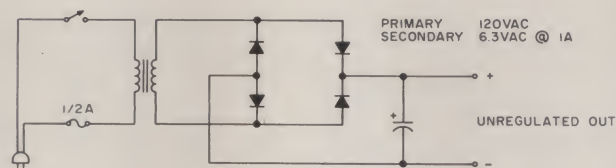


Fig. 5. Full wave bridge circuit.

should glow more brightly than it did connected across 6.3 V ac. Use care in this step and stay clear of the 120 V ac circuitry.

Theory: Alternating current (and voltage) or ac comes in on the line cord. The SPST switch provides a means of *breaking* or *making* the current path, allowing us to turn on or turn off the power to the transformer. The fuse provides a safety valve, and will burn out (open or blow) if something is drastically wrong, or something fails in a circuit. Always install a fuse in a circuit that feeds power to any transformer. The fuse is relatively inexpensive and much cheaper than the trans-

magnetic field is necessary to accomplish this. Direct current has a steady magnetic field, and if we connect dc to a transformer, we will get smoke. *Never connect ordinary dc to a transformer winding.*

The transformed ac, which in our power supply is transformed from 120 V ac to about 12 V ac out (a 10:1 reduction), comes out to the *secondary* and is then fed to a pair of diodes. Centertapping the secondary winding of the transformer produces two identical ac waveforms, 180 degrees out of phase with each other. As one ac waveform goes in a positive direction, the other waveform goes in the opposite direction

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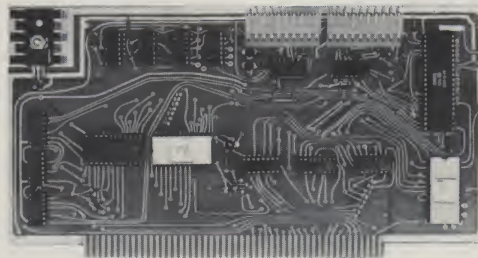


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comparable dc voltage. Since part of the time the ac is zero, the 120 V ac RMS voltage must go higher than 120 volts to provide the same heating capability as 120 volts dc. In fact, it must go 1.41 times the RMS value. Since the ac also swings an equal distance in the negative direction as well, the peak-to-peak (P-P) value, from the top of the positive-going waveform to the bottom of the negative-going waveform, is 2.82 times the RMS value.

The filter capacitor in a power supply circuit will therefore charge up to this peak value, or about 1.5 times the RMS value. The diode that is conducting is subjected to the ac voltage plus the dc voltage from the capacitor. So the peak inverse voltage (PIV and PRV, respectively) rating of the rectifier diodes must be about 3 times the RMS voltage of the transformer. At 3xRMS there is no safety margin for diode. In a TV set that operates directly from the ac line, the rectifier diode has a PIV of 400. This is 3xRMS plus a safety factor.

The RMS value of our circuit is 6.3. Multiplying by 3 gives almost 19 volts. Adding a little for the safety margin, you can see why we specify 25 volt PIV diodes. Our transformer will only deliver 1 Amp of current, so we can easily get by with 1 Amp diodes. You may use any diodes with more PIV rating or more current rating.

Capacitance

Capacitors store electrons. The more microfarads of capacitance, the more electrons they will store. Therefore the larger the capacitor the better the filtering of the power supply.

In our power supply circuit, 1000 uF makes a reasonable filter. 2000 uF would make a better filter capacitor, and 5000 uF would be better still.

Capacitors have another rating that we need to

discuss. Capacitors have a dc working voltage rating. This is the dc voltage at which they are guaranteed to work without breaking down and shorting. Ha! Sometimes they short anyway.

The dc produced by our circuit will be around 10 volts. We possibly could get by with a 10 volt capacitor. We would be far better off to use a capacitor rated at 12 V dc, and one at 15 V dc

not necessarily what the author of the article put into his circuit.

Transformers

If you have a transformer with a 1 Amp 6.3 volt secondary, it can be used for the console power supply. Use the full wave bridge circuit of Fig. 5. If your 6.3 volt transformer has a current rating of more than 1 Ampere, you may be

function properly. Since we are haywiring the unregulated supply, try what you have on hand before you dash out and buy what I specify to be used. You can always buy the components later if you are dissatisfied with the results.

Safety

Stay clear of the ac line circuitry when this power supply is plugged in. Never work on any circuit that is plugged in. When measuring voltages on any HOT circuit, use caution. Think safety. Act safely. I'll give you a simple safety rule: follow it. The life you save may be your own.

Safety Rule: *If you must work on a live circuit, place your left hand in your rear pocket, and use only one hand. You can get a nasty shock, but you probably won't get killed.*

This safety rule normally provides sufficient protection while working on 120 volt circuits. We are attempting to prevent current from flowing through the heart. With only one hand capable of contacting electrical power, the path through the heart is eliminated. Shoes and their insulation are usually sufficient to block that path. Of course, if you are standing in a puddle of water outside, this safety rule won't help much. There is no such thing as a foolproof safety rule, but this very simple one will help.

Do not connect the output of the power supply directly to the console. 10 volts is definitely not a TTL level. If you connect this output directly to the console, you will ruin all your hard work behind the panel and will have to make a lot of replacements. We must regulate the 10 volts to the TTL level with appropriate circuitry.

Voltage Regulation

The output voltage of our power supply is about 10 volts. As the load (amount of current taken from the power supply) increases this voltage sags lower and lower. What

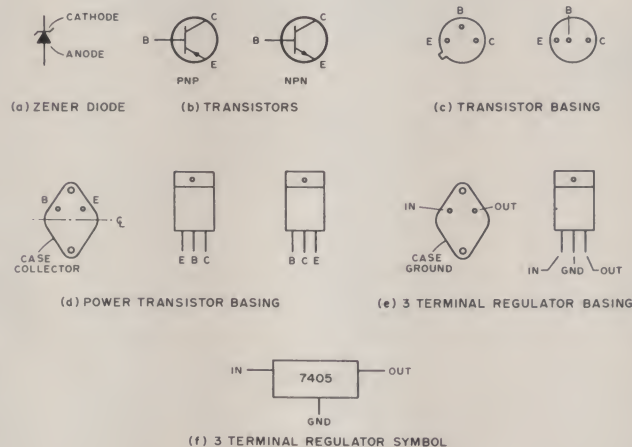


Fig. 6. New symbols added.

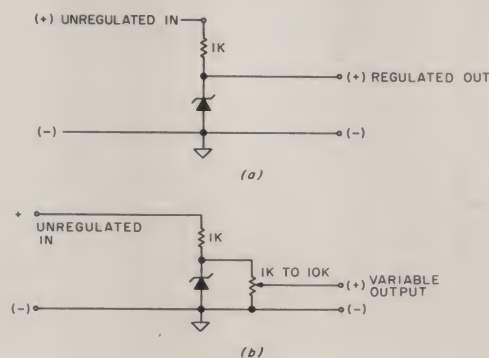


Fig. 7. Zener diode regulation.

working would give us the necessary safety margin.

As you learn more electronics, you will discover that parts used in a circuit can be changed to different values and the circuit will still work satisfactorily. In fact, the whole philosophy of Kilobaud Klassroom is to use what you have on hand. Try it and see if it works. As your knowledge of electronics expands, your treatment of published circuits will change. The idea is to make them work with what you have,

disappointed in the results. A smaller transformer has a little extra voltage (a few more secondary turns) out because it is not as efficient as a heavier current transformer. Our power supply produces about 10 volts for this very reason, and a 1 Amp 6.3 volt transformer will produce about 9 volts with the bridge circuit for the same reason. Voltage regulators need a little extra margin of voltage to work on, so they must have more in than you want out to

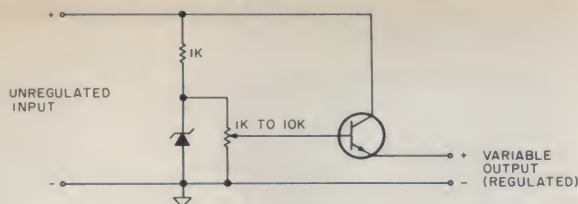


Fig. 8. Variable output regulator.

we need is some circuitry that will hold the output voltage at 5 volts over a wide range of current drain. Such circuitry is called voltage regulator circuitry.

We will start with a simple regulator, progressing on to more complex circuits. For a power source we will use the unregulated power supply just completed. After we finish the next series of experiments, the power supply will be built into the console. Before you go one step farther, disconnect the front panel from the Superstrip. Pull the rail feeder wires coming from the bolts in the front panel out of the Superstrip rails. Push them to one side. The two pairs of jumpers in the center of the Superstrip can remain, but all that work behind the front panel *must* be disconnected from the Superstrip.

Connect two fairly long wires from the + and - on the filter capacitor, and plug these into the Superstrip power distribution rails. We will use the unregulated power supply and the Superstrip in this configuration for the next series of experiments. If a voltmeter is not available, proceed to the portion of experiment #18 dealing with the three-terminal regulators and do only that section. Later when you do have access to a voltmeter, come back to experiment #18.

Experiment #18 Voltage Regulation

Purpose: a. To investigate the zener diode voltage regulator. b. To examine the emitter follower. c. To study the three terminal regulator. d. To look at the 723 regulator chip.

Equipment: 1) A zener diode of less than 9 volts, or a silicon transistor. 2) An NPN power transistor of 1 Amp (or more) capability. 3) A potentiometer (pot), 1k to 10k. 4) A 5 volt, three terminal regulator, LM 309K, LM 340-5, 7805, etc. 5) A 723 linear IC in a DIP package.

New Symbols: Refer to Fig. 6 for the new symbols added.

Circuits: Fig. 7 is the circuit for the zener diode portion of the experiment. Fig. 8 is the circuit for the emitter follower. Fig. 9 should be used for the three terminal regulator. Fig. 10 shows the circuit for the 723 regulator.

Procedure: Read the theory section first on each type of regulator circuit. When you feel that you understand what the circuit is supposed to do, connect it to the console breadboard and verify its operation. A voltmeter is mandatory for

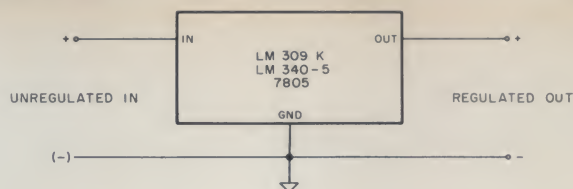


Fig. 9. Three-terminal regulator circuit.

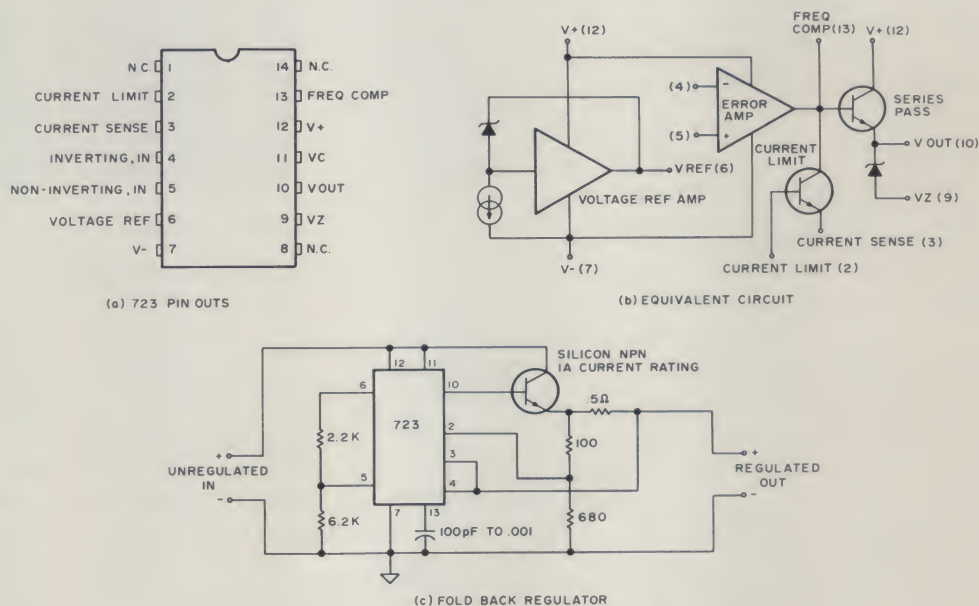


Fig. 10. 723 regulator circuit.

these experiments. If a voltmeter is not available and you can't find one of our resource persons mentioned earlier, you will be able to do only part 4, the three-terminal regulator circuit.

Theory: A zener diode is a special kind of diode. It is made to operate with reverse bias applied to it; + to the cathode, and - to the anode. A current limiting resistor must be used in series with the zener diode. As the voltage across the zener increases, a voltage level will be reached at which the zener will break down and conduct. Once this zener voltage is reached, the voltage across the zener diode remains constant or regulated. A zener diode will only supply enough current for one or two ICs. Thus the simple zener diode regulator must be helped out if it is to provide the regulation for a Superstrip full of chips.

Zener diodes average around 50¢ each. The base-

emitter junction of silicon transistors is a zener diode. There may be some that don't zener, but I haven't found them yet. This zener voltage is between 4 and 10 volts, with the great majority lying in the vicinity of 9 volts. So a base-emitter junction makes a 10¢ zener diode. Try one and see. If the zener voltage of the particular transistor that you try happens to zener above 10 volts, you will not be able to see the zener effect without finding a power supply that will go higher in voltage. If you read 0.6 volts when you have the transistor diode or the zener diode in the test circuit, you have the junction forward biased (same as a short). Reverse the connections to anode and cathode to reverse bias the diode and cause the zener action to take place.

Refer to Fig. 7b. If a pot is connected across the zener diode, the wiper of the pot can be moved from ground

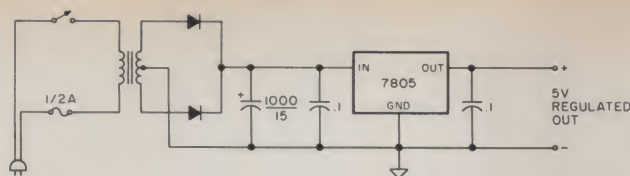


Fig. 11. Console power supply and regulator.

(zero volts) up to the zener voltage. Since the voltage across the zener is regulated, the voltage across the pot is also regulated.

The Emitter Follower

Refer to Fig. 8. Here a transistor is connected to the variable output voltage of the pot. The emitter voltage follows the voltage applied to the base, hence the name emitter follower. Note that the collector of the transistor goes straight to + in this circuit. This is an easy way to quickly spot the emitter follower circuit.

The base-emitter junction of a transistor is a diode; therefore this diode will drop 0.6 volts when it is forward biased. The output of an emitter follower can never equal the input on the base; it will always be one diode drop below the base voltage. The circuit will run our console however, because the emitter follower is a current amplifier. Connected as shown in Fig. 8, we have a variable output voltage power supply which can be very handy at times.

We just said that the emitter follower circuit cannot amplify voltage. It is, however, a current amplifier. This can be demonstrated with a couple of numbers. Suppose the control current is 10. If the dc gain (called the *Beta* of the transistor) is 100, then the output current capability of the combination is 10×100 or 1000. While I did not bother with the units, milliamps can be added to the numbers ($10 \text{ mA} \times 100 = 1000 \text{ mA}$ or 1 Amp). Thus a zener control current of only 10 mA can control 1 Amp at the output of the emitter follower.

Now, this circuit must

have something wrong with it or OM Young would have used it for the console power supply. That's right; it's too simple. 1) You have to set the output voltage with a meter under circuit load and 2) this circuit does nothing about the ripple problem. As the load increases, so does the ripple content of the output dc. The ripple content can be lowered by increasing the size of the filter capacitor, so the circuit is a good one to add to your collection of tricks to get various jobs done. To combat the ripple problem, we need something we might call "reverse amplification".

Three-Terminal Regulators

One of the newer devices that has been developed in this area is the three-terminal voltage regulator. The terminals are input, ground and output. You buy the regulator for the voltage that you want out, connect slightly higher unregulated voltage to the input terminal, ground the case, and take the output voltage and use it.

There is a whole bunch of goodies inside the package; several zeners, amplifying transistors, a series pass transistor, and several resistors. All this circuitry regulates the output and takes care of what I called reverse amplification. Most of these devices will handle an Amp of current, so for our console power supply regulator this is the simple way to go. Newer four-terminal regulators are adjustable, but they are more expensive. For our purposes, the 5 volt, three-terminal regulator is entirely satisfactory.

Regulator Chips

Another class of voltage

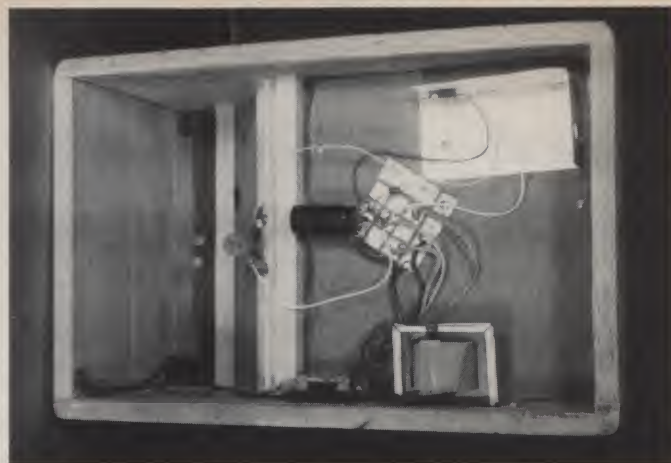


Photo 3. Console power supply and regulator installed under console.

regulators is exemplified by the 723 (see Fig. 10). This old veteran can be used to make a regulator from 2 to 35 volts. It has an internal series pass transistor capable of 150 mA of current and can be used for both positive and negative regulation. It can have external, remote shutdown. It can be configured to have foldback current limiting. Coupled with an external series pass transistor, or transistors, any amount of current can be regulated.

Foldback current limiting means that if we inadvertently short + and - together, the regulator shuts down. Nothing happens. Everything returns to normal as soon as the short is removed. With high school students, it is the only way that my lab supplies have survived. You should investigate all these circuits in the interest of expanding your knowledge of electronics.

Finishing The Console

When the power supply and voltage regulator circuits are all functional, the entire supply can be built into the console (see Photo 3). The space immediately below the Superstrip should be used for this purpose. If the transformer you have selected is too large for this space, it will have to be mounted towards the back where there is more space available.

A piece of copper clad board, cut into pads with a hacksaw blade makes a handy solder terminal on which to mount parts. A piece of aluminum or copper bolted to the 5 volt, three-terminal regulator serves as a heat sink. Use the largest heat sink that will fit into the available area. My students are using part of an old chassis from an earlier era for a heat sink as seen in the photograph.

The series diode used to drop the 6.0 volts of the battery to TTL level can now be eliminated. Since the power supply will now be permanently attached to the Superstrip, reverse polarity protection is no longer needed. The console power disconnect switch can now be wired to turn the power supply/voltage regulator on and off. The final suggested version of the console power supply is shown in Fig. 11.

Preview

In class session 5 we will have a continuity tester that I call the Squawker. We'll take a look at the rest of the NAND gate family, the 3-input, 4-input and 8-input gates. This will be followed by the NOR gate. Then we'll look at all four logic functions: AND, NAND, OR and NOR.

We'll need the following ICs: another 555, a 7410, 7420, 7430, 7402. Sierra Electronics package price for this group is \$2. ■



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Seals Electronics

... a visit with the memory people

*J. Tom Badgett
1917 Washington St.
Bluefield WV 24701*

What's behind your demand for perfection and quick delivery; why do you work so hard?" I asked Bruce and Sandra Seals over lunch in Knoxville, Tennessee. We'd spent the morning discussing the

founding and operation of Seals Electronics, and I reflected on that during the brief, almost embarrassed silence which followed my question. An understanding spark passed between them. Bruce smiled. It was Sandra who answered:

"I guess it's really because Bruce grew up in Lonsdale — you know Lonsdale?"

I did. A low-income area

of Knoxville where youngsters and families survive on the hope that things will get better or they'll find a way out. Things are better now, but in Bruce's day it seemed few broke the chain and realized their dreams of a better life.

"I never want to be that low again," Bruce responded softly to my quizzical look.

That isn't likely. It's hard

to say exactly how the series of events meshed for Bruce and Sandra to put them on top of a rapidly growing electronics firm with an excellent product and an even better reputation. But you can bet their success came in part from that childhood motto Bruce heard so often in Lonsdale: "No guts, no glory." It was probably that motto that got him into the

Army at an early age, and made him transfer to the Air Force to pursue an electronics career. It was this decisiveness that got Sandra and Bruce together. They met when Bruce was in Knoxville on a two-week leave. They didn't see each other again for nine months, but their minds were made up. They married the next time Bruce came home.

Bruce was working for an electric fence company when he got his first patent. He suggested a battery operated charger for the fences. The boss told him if it could be done an electronic charger would have replaced the old electromechanical models years ago. Just the kind of challenge Bruce needed. Within a few minutes he had a design, and when he built it up, it worked.

There was the fence charger service company; a good paying job as a design engineer for Oak Ridge Technical Enterprises Company (ORTEC), a nuclear instrumentation company; a brief stint wholesaling Teletype sets to Western Union; and a Tennessee-wide Mits-Altair franchise, the Bytetronics store in Knoxville. Some of these jobs ran concurrently.

Sandra wasn't sitting around. She worked for some time with the state rehabilitation and welfare office, but when family businesses needed her, she was typist, bookkeeper, order-filler, mail-room clerk. Now with Seals Electronics she sorts parts (so do Bruce and the two Seals youngsters), takes care of orders, handles book-keeping and the files. In the beginning she even built some of the Seals boards for sale to customers who wanted theirs assembled.

Seals Electronics grew out of all of these experiences, but it probably was the Altair dealership which offered the final initiative. Bruce built up an early Altair kit in February of 1975. In July he was in Albuquerque to talk with

Ed Roberts about an eastern service company for the Mits product. He came back to Tennessee with a state-wide franchise instead. Bytetronics was the first Altair store in the East and they'd been promised three day delivery from Albuquerque. But Mits was having growing pains. Three days became three weeks, then six. Bruce ended up with \$14,000 in customer deposits for products he couldn't get, and "a very uncomfortable feeling."

Since most of the delays were on memory boards, it seemed natural to roll their own. Drawing on his own expertise and that of nine other engineers in the nuclear industry, Bruce came up with the now-familiar Seals design.

Those \$14,000 in deposits were haunting him even more than the old Lonsdale motto, so he vowed he wouldn't advertise anything he couldn't ship in ten days or less.

"I guess our marketing philosophy is just that we're treating the dealers and the

public like we wanted to be treated when we were a dealer and a hobbyist," he says.

The first 4K memory card has grown into a plethora of Seals products already available or on the way. Interestingly, the 4K card was dropped in favor of the 8K version ("I felt we could get twice the density on the card, and the 4K drew too much current. I thought we could do much better") and was later sold to S. D. Sales. So the 4K memory offered by S. D. Sales is basically the original Seals board which Bruce says still is "a good card."

Because Altair provided the first computer experience, the first Seals boards were built on the Altair bus. But Bruce was afraid to advertise that his boards would work successfully in any Altair bus system until he had built the system and tried it. That's still the Seals policy. They have six machines up and running to test the Seals board compati-

bility and help the engineers in design work. More computers currently are under construction and check-out and new Seals products are coming out all the time.

By now you've probably read the ads for the 8K memory and other Southwest Tech products, and there's a 4K ROM card set up for fast or slow 1702-As or 5203s. Coming soon, Bruce says, is Seals BASIC on that 4K ROM card, a 16K static memory, an ac I/O card, video interface and more.

Indicative of his confidence in the Seals products, Bruce didn't hesitate to answer my questions about the 16K memory design: "The design is perfect. There's nothing wrong except for supply of those 4200 chips." Sticking with his ten day delivery policy, Bruce refuses even to advertise the new board until he can be assured of enough of the SEMI 4200 memories to meet the expected demand.

"Everything we've got is



A bench full of 8K memory board kits ready for packaging and shipment. Seals guarantees 10-day delivery, but usually an order received by 2 pm goes out the same day via UPS.

second or third sourced," he says. He requires all of his parts vendors to have impounded inventories at least half of the amount of the blanket order. And he tells dealers: "Just let the quality sell itself."

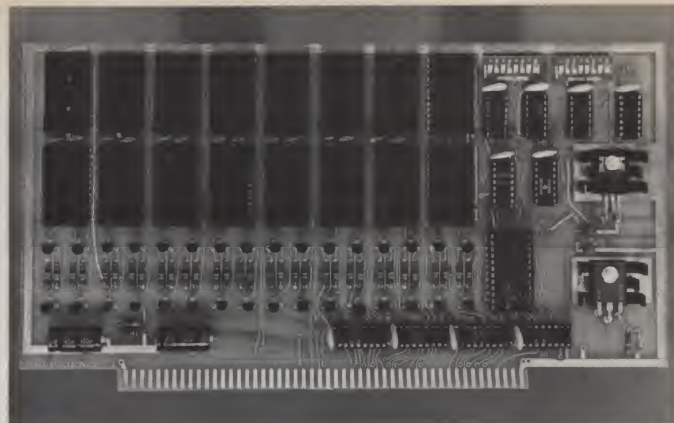
Why is he so sure of the board's design? That's easy when you hear the procedure to get a product on the market. First, the engineers start from scratch, usually without even having seen anybody else's design. After debugging a wire-wrapped version of the new product, twenty to forty PC boards are made and built up. The prototypes are loaned to area hobbyists and sold to dealers at a discount for evaluation. Some go to the Tennessee Valley Authority's environmental evaluation chamber in Knoxville, others to NASA testing facilities in Huntsville. After thirty to sixty days, input from these tests is evaluated and any design changes are made. Next, perhaps 100 boards are made up. If no problems emerge at this point, full production is begun.

"I'm surrounded by a tremendous amount of design talent in this area and I'm just tapping it," Bruce says. "But they're skeptics at heart, even of their own designs. They

want everything perfect." This push for perfection comes from the nuclear instrumentation industry where high density electronics dealing with 500 MHz signals are common.

As if to show his design expertise isn't confined to Tennessee, Bruce dropped a small PC board on the desk. It was a prototype for the new Seals cassette recorder interface from a Cincinnati designer. He told the engineer he had a maximum of 5.1 x 10 inches to work with (the standard Altair board), and he got a 2 x 3 inch board back. The production version may be even smaller because the engineer has since replaced all the components on the board with a single integrated circuit and two potentiometers! It's supposed to operate at speeds up to 1200 baud and will be on the market sometime after July.

Bruce and Sandra Seals are justifiably proud of the reputation for quick delivery and quality products they've built up in a short time. They talk about this aspect of the business freely. It is like pulling teeth, however, to get them to tell me about future designs. The real bomb came out of the clear blue, after we'd spent hours rambling



Already available is this Seals 4K ROM card. It'll take up to 16 1702-As or 5203s, each with its own V_{gg} clocked for low power consumption, and has switched-selected wait states to accommodate the slowest 1702-A.

over a variety of subjects:

"Our Emulator will be out in the fall," Bruce said offhandedly. I didn't say anything. I wasn't sure what he was talking about.

"Yeah," he continued, "It'll use a 3000 series Intel chip with all the individual microprocessor characteristics stored in ROM. It can act like an 8080, a 6800, a Z-80 or even the LSI-11, which is a 16-bit processor."

The ROM instruction set for individual processors could be changed for about thirty bucks, allowing an Emulator owner to run anybody's software simply by unplugging a few ROMs and substituting the new instruc-

tion set. Bruce finally mentioned that this Emulator card will be housed in a nice cabinet with power supply, motherboard and I/O for about \$500.

Look for the first PUP-1 (for Peripheral Universal Processor, Bruce says, but what's a baby seal ... ?) about October. It'll have only three switches: a key switch for power on-off, and two switches to give the operator some control over reset functions.

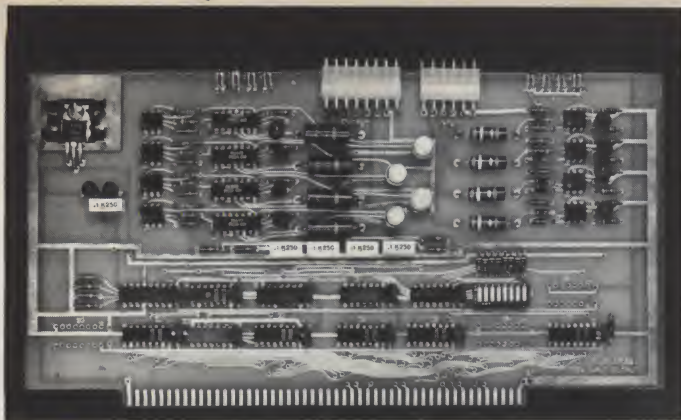
Just as the first Seals memory boards were designed to fill a need Bruce himself felt, the PUP-1 evolved because Seals products now have outlets in England and



Bruce personally keeps his hand on all phases of product development. Here he's checking an overlay for the new 16K memory board — the layout from which the production negative for the memory card is made.



Sandra runs the office at Seals Electronics, and Bruce is content to leave it that way. If you call to place an order or discuss a problem, you'll probably talk with Sandra.



The Seals ac controller has 3,000 volt optical isolation, four I/O lines with LED status lights and can be fully computer controlled.

Canada. There aren't enough computer mainframes from other manufacturers in these countries to support the volume he'd like, so he's introducing his own. And, he promises to continue 10-day deliveries to customers in England and Canada!

"It's not a complicated philosophy, really. Anybody should be able to do it," Bruce says.

But there's a lot behind this simple philosophy. For one thing it's the easy, friendly relationship Bruce and Sandra have with each other — a relationship that seems to infect anyone who is around them. After only a few minutes with them I had trouble remembering that we'd only just met. It's the same way with the people representing their parts and equipment suppliers. Salesmen don't call on Seals Elec-

tronics; friends drop by to ask Bruce and Sandra if they need anything. And, they say, things are going to stay that way, even as they prepare to move into a new, larger plant.

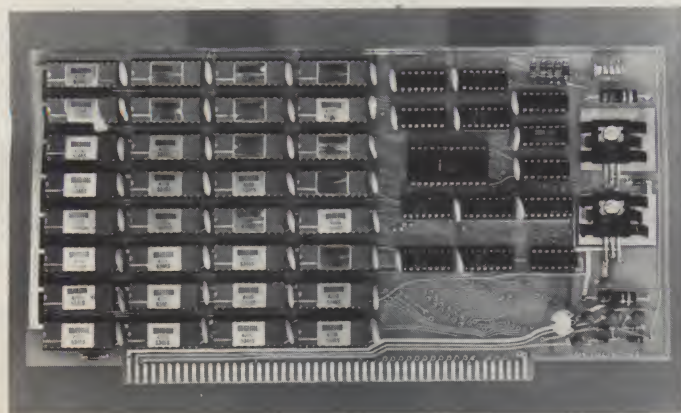
"The attitude and the philosophy of this business is going to stay the same, or we'll restrict our own growth," Bruce promised. "Again, we're just treating people like we want to be treated."

"This is more than just a business for you," I observed.

"There aren't many companies in this business with their own name on it. We're not hiding under a fake name," Bruce responded.

"It's really a thing of the future. It's inevitable," Sandra sparkled, fingering a necklace which is a likeness of a baby seal.

Bruce: "It's our first love." ■



Seals' "perfect" 16K static memory card uses SEMI 4200 chips.

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Try an 8080 Simulator

... valuable debugging technique

A simulator is undoubtedly a valuable tool in software troubleshooting, and Lee's article describes one for debugging 8080 code. Now... who's going to write one for the 6800 or 6502? Better yet, who's going to get busy and write a simulator for running (not debugging) 6800 code on an 8080 (and vice versa)? I'm really surprised nobody has done it before. If you stop and think about it, the idea makes a lot of sense. Essentially you would have two machines! The software running under the simulator would, of course, run slower, but in most cases this wouldn't be such a big deal ("most cases" being game programs, right?). — John.

So that new program doesn't work. I have found that debugging it usually takes longer than writing it. If only I could see what is going on inside the computer, correcting a program would be a lot easier. The simulator presented here does away with having to guess what is happening. It allows me to single step through a program, and after each instruction, shows me all the internal registers in the micro-

processor. In addition, the program being executed can

be run until a breakpoint address is reached.

```
A =1234      BC=5678
DE=9ABC      HL=DEFO
PC=0123      SP=4567
01 1234
23 5678
45 9ABC
67 DEFO
89 1234
AB 5678
*CD 9ABC
EF DEFO
01 1234
23 5678
45 9ABC
67 DEFO
```

Fig 1. Sample output of the simulator.

The Display

Written for use on an 8080, the display produced by the simulator is shown in Fig. 1. The first three lines show the contents of all the registers. The first two hexadecimal digits after A = is the accumulator, and the next two is the flag register. The first column of numbers is sequential memory bytes starting at six less than the current address of the program's PC register and continuing to PC + 5. The asterisk marks the byte pointed to by PC and is the first byte of the next instruction to be executed. The second column is

	BIT							
	7	6	5	4	3	2	1	0
LXI B	0	0	0	0	0	0	0	1
LXI D	0	0	0	1	0	0	0	1
LXI H	0	0	1	0	0	0	0	1
LXI SP	0	0	1	1	0	0	0	1

Table 1.

stack locations, the first number being the last value pushed onto the stack.

Flowchart

A flowchart of the simulator is shown in Fig. 3. First the length of the instruction pointed to by the PC of the program must be determined. If the instruction is sequential (not a jump, call, or return), it is loaded into the simulator. The registers, with the exception of the PC, are loaded into the microprocessor, and the instruction executed. Non-sequential instructions are not directly executed but are carried out by various software routines. After completion of one instruction the registers are stored. If in breakpoint mode, and the program count does not equal the breakpoint address, the simulator jumps back to the beginning and executes the next instruction. Otherwise, the register contents are displayed and the simulator waits for a keyboard input before continuing.

The Program

A complete listing of the simulator is given in Fig. 2. It should be noted during this discussion that the simulator retains control by never loading the PC register with the actual PC value of the program under execution. The program begins by calling the subroutine LOC, which inputs a four digit hexadecimal starting address from the keyboard. The ASCII digits are converted to binary, and upon return the number is stored in HL. Next a zero is stored in the breakpoint indicator, putting the simulator into single-step mode. The data stored at the stack locations are shown in Fig. 4. Zeroes are also stored at INST and INST + 1, the reason for which will be explained later. Steps 11 through 55 determine the length of the instruction to be executed. As an example consider steps 19 through 20, which determine if the

instruction is an LXI. All four LXI instructions are shown in binary in Table 1.

Note that with the exception of bits five and four all the instructions are the same and all combinations of bits five and four are used. The ANI CF at 1D forces bits four and five to zero, causing all the LXI instructions to look like a LXI B. The CPI 01 at 1F checks for an LXI B and a jump is taken if the compare is equal. All the rest of the instructions in this group utilize this same method except the JC at 2F. Prior to this step all the two and three-byte instructions less than CO have been detected so at this point the instruction is one byte in length if it is less than CO.

Let's follow a two-byte instruction. After detection a jump is made to TWOB. TWOB retrieves the two bytes from the program, stores

them in the simulator at INST + 1, and INST + 2 and updates HL which contains the program's PC value. The program's new value of PC is stored and the rest of the register values are loaded into the microprocessor. The simulator then falls through to the instruction retrieved from memory and executes it. It also executes a NOP at INST. Recall that zeroes were stored at INST and INST + 1 earlier. A three-byte instruction would use all three locations, and a one-byte would have two NOPs and the one-byte instruction.

Now that the instruction has been executed the internal registers must be stored. But a quandry develops; the only way to obtain the flags is to do a PUSH PSW which would dictate that the value of the stack pointer be stored and then changed first. However, the only way to get this

01E3	Stack	0,1	Breakpoint mode
01E5	Stack	2,3	Breakpoint address
01E7	Stack	4,5	Return address storage
01E9	Stack	6,7	
01EB	Stack	8,9	ASCII address (during DSPY)
01ED	Stack	10,11	Register address (during DSPY)
01EF	Stack	12,13	SP
01F1	Stack	14,15	PC
01F3	Stack	16,17	L,H
01F5	Stack	18,19	E,D
01F7	Stack	20,21	C,B
01F9	Stack	22,23	Flags,A
01FB	Stack	24,25	

Fig. 4. Listing of the data stored at the stack locations.

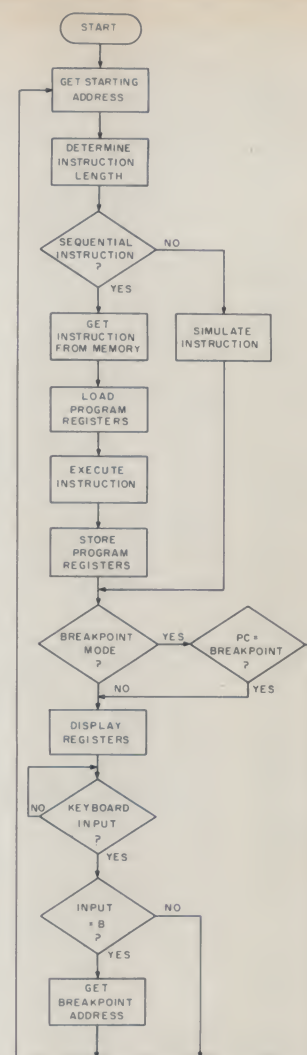


Fig. 3. Flowchart of simulator program.

Fig. 2. Program listing.

Begin Program			
0000	31 FD 01	LXI SP, STACK+26	Initialize stack pointer
0003	CD 15 02	CALL LOC	Get starting address
0006	AF	XRA A	A=0
0007	32 E4 01	STA STACK+1	Put program into single step
Begin Execution of Next Instruction, HL = Instruction Address			
000A	31 F9 01	Next LXI SP, STACK+22	Set stack pointer to PSW
000D	AF	XRA A	A=0
000E	32 1C 01	STA INST	Store NOP instruction
0011	32 1D 01	STA INST+1	Store NOP instruction
0014	7E	MOV A,M	Load instruction
0015	E6E7	ANI OE7H	Zero out bits 3 and 4
0017	FE 22	CPI 22H	
0019	CA FD 00	JZ THRB	Jump if LHLD, SHLD, LDA, or STA
001C	7E	MOV A,M	Load instruction
001D	E6 CF	ANI OCFH	Zero out bits 4 and 5
001F	FE 01	CPI 1	
0021	CA FD 00	JZ THRB	Jump if LXI
0024	E6 C7	ANI OC7H	Zero out bits 3, 4, and 5
0026	FE 06	CPI 6	
0028	CA 02 01	JZ TWOB	Jump if MVI
002B	FE C7	CPI OC7H	
002D	CA F4 00	JZ ERST	Jump if RST
0030	FE CO	CPI OCOH	One byte instruction?
0032	DA 07 01	JC ONEB	Jump if less than CO
0035	FE C6	CPI OC6H	

0037	CA 02 01	JZ TWOB	Jump if two byte 'immediate'
003A	7E	MOV A,M	Load instruction
003B	FE F9	CPI OF9H	
003D	CA 07 01	JZ ONEB	Jump if SPHL
0040	FE E9	CPI OE9H	
0042	CA E8 00	JZ EPCHL	Jump if PCHL
0045	E6 F7	ANI OF7H	Zero out bit 3
0047	FE D3	CPI OD3H	
0049	CA 02 01	JZ TWOB	Jump if IN or OUT
004C	E6 E7	ANI OE7H	Zero out bits 3 and 4
004E	FE E3	CPI OE3H	
0050	CA 07 01	JZ ONEB	Jump if XCHG, XTHL, EI, or DI
0053	7E	MOV A,M	Load instruction
0054	E6 CB	ANI OCBH	Zero out bits 2, 4, and 5
0056	FE C1	CPI OC1H	
0058	CA 07 01	JZ ONEB	Jump if POP or PUSH
005B	7E	MOV A,M	Load instruction
005C	FE C3	CPI OC3H	
005E	CA B7 00	JZ EXEC1	Jump if JMP
0061	FE CD	CPI OCDH	
0063	CA B7 00	JZ EXEC1	Jump if CALL
0066	FE C9	CPI OC9H	
0068	CA DA 00	JZ ERET	Jump if RET
006B	E6 38	ANI 38H	Zero out bits 0, 1, 2, 6, and 7
006D	OF	RRC	
006E	4F	MOV C,A	Save in C
006F	OF	RRC	
0070	81	ADD C	form values 0, 6, 12, . . . 48 (decimal)
0071	4F	MOV C,A	Save in C
0072	06 00	MVI B,O	B=0
0074	EB	XCHG	Save PC value in DE
0075	21 7B 00	LXI H, COND	Load base address
0078	09	DAD B	Form relative address
0079	F1	POP PSW	Get flags
007A	E9	PCHL	Jump to relative address
007B	C2 B5 00	JNZ EXEC	
007E	C3 A8 00	JMP SKIP	
0081	CA B5 00	JZ EXEC	
0084	C3 A8 00	JMP SKIP	
0087	D2 B5 00	JNC EXEC	
008A	C3 A8 00	JMP SKIP	
008D	DA B5 00	JC EXEC	
0090	C3 A8 00	JMP SKIP	
0093	E2 B5 00	JPO EXEC	
0096	C3 A8 00	JMP SKIP	
0099	EA B5 00	JPE EXEC	
009C	C3 A8 00	JMP SKIP	
009F	F2 B5 00	JP EXEC	
00A2	C3 A8 00	JMP SKIP	
00A5	FA B5 00	JM EXEC	

Condition not Met, Advance PC value to next Instruction

00A8	EB	Skip	XCHG	HL = PC value
00A9	7E		MOV A,M	Load instruction
00AA	E6 07		ANI 7	
00AC	23		INX H	Increment PC value
00AD	CA EB 00		JZ EPCH1	Jump if return
00B0	23		INX H	Increment PC value
00B1	23		INX H	Increment PC value
00B2	C3 EB 00		JMP EPCH1	

Condition Met, Execute Instruction

00B5	EB	Exec	XCHG	HL = PC value
00B6	7E		MOV A,M	Load instruction
00B7	E6 06	Exec1	ANI 6	
00B9	CA DA 00		JZ ERET	Jump if return
00BC	23		INX H	Increment PC value
00BD	5E		MOV E,M	Get address
00BE	23		INX H	
00BF	56		MOV D,M	
00C0	EB	Exec2	XCHG	
00C1	22 F1 01		SHLD STACK+14	Store new PC value
00C4	31 EF 01		LXI SP, STACK+12	Load SP address for STOR
00C7	FE 02		CPI 2	
00C9	CA 38 01		JZ STOR2	jump if jump instruction
00CC	2A EF 01		LHLD STACK+12	Get stack address
00CF	13		INX D	Increment return PC value
00D0	2B		DCX H	Decrement SP value
00D1	72		MOV M,D	Store return PC value in stack
00D2	2B		DCX H	
00D3	73		MOV M,E	
00D4	31 F1 01		LXI SP, STACK+14	Load SP address for STOR
00D7	C3 37 01		JMP STOR1	

Process Return

00DA	2A EF 01	Eret	LHLD STACK+12	Get stack address
00DD	5E		MOV E,M	Get return PC value
00DE	23		INX H	
00DF	56		MOV D,M	
00E0	23		INX H	
00E1	31 F3 01		LXI SP, STACK+16	
00E4	D5		PUSH D	Store new PC value
00E5	C3 37 01		JMP STOR1	

Process PCHL

00E8	2A F3 01	Epchl	LHLD STACK+16	Get HL value
00EB	22 F1 01	Epchl	SHLD STACK+14	Store new PC value
00EE	31 EF 01		LXI SP, STACK+12	Load SP for STOR
00F1	C3 38 01		JMP STOR2	

register value is to load HL with zero and do a DAD SP, which clears the carry flag causing its original state to be lost. To get around this problem the state of the carry flag is checked by a JC at 125. Either the flag is left cleared after the DAD SP if the JC is not executed, or it is reset after the double add.

Let's now go back and look at those non-sequential instructions. All these instructions must be simulated since the PC cannot be loaded into the microprocessor. The unconditional instructions are singled out first RST, CALL, JMP, and RET. If the instruction is conditional, the simulator must determine whether to execute or skip it. Bits three, four, and five of these instructions are the same for each condition, zero for JNZ, CNZ, RNZ, 001 for JZ, CZ, and RZ etc. All but these three bits are zeroed out by the ANI 38 (hex) at 68. Two RRCs are performed, and the results of the two shifts are added, leaving values of 0, 6, 12, . . . 48 (decimal). This value is added to a base address and the flags are loaded into the microprocessor. A PCHL transfers control to the appropriate pair of jumps. A "no-zero" would go to 78 where, if the condition is met, the JNZ is taken and the instruction executed. Otherwise the following unconditional jump transfers control to the skip location. Similar pairs of jumps check all the other possible conditions.

SKIP updates the PC, one for return and three for jumps and calls, and then proceeds to the breakpoint test. At EXEC returns are first sorted out and handled separately; for a jump or call the next value for PC is retrieved from the program and stored in the location containing the program's PC value. A jump instruction proceeds to the storage routine while a call simulates stack action to store the return address. The returns sorted out earlier also simu-

late the stack to obtain the next PC value. A PCHL loads the value of HL and stores it in the location for PC. An RST puts the call address in DE and then goes to the call routine to be handled like a call instruction.

At 138 a check is made to determine if the simulator is in breakpoint mode. If it is, the previously stored breakpoint address is compared with the current PC value, and if not equal, the next instruction is executed. If equal, or not in breakpoint mode, the DSPY routine is entered. Here three ASCII characters are output to indicate register type; then the CONV routine is called twice to output the register value in hex. To output a CR after every second register pair the loop count in C is checked. Each time it is an odd number the output character count is increased by one, causing a CR to be issued after the spaces.

After all the registers have been displayed the PC and stack values are output. The series of POPs at 182 thru 184 load SP into DE and PC into HL. These values are returned to the stack for storage. At 187 the value of SP is pushed a second time and will be used during the display routine. The PC value is decreased by six and C is loaded with the loop count.

At 18F the output process begins. C is checked and when equal to six an asterisk is output to indicate the instruction to be executed next. One line of output consists of two spaces or an asterisk and a space, the PC value, three spaces, the stack value, and a CR.

Finally the simulator waits for an input before continuing. If the input character is a B, the simulator calls LOC to get the breakpoint address, and in either case jumps to NEXT to begin processing the next instruction.

Using the Simulator

To use the program start at location 0 and input a four

Process RST					
00F4	7E	Erst	MOV A,M	Load Instruction	
00F5	E6 38		ANI 38H	Get RST address	
00F7	5F		MOV E,A	Put new PC value into DE	
00F8	16 00		MVI D,O		
00FA	C3 CO 00		JMP EXEC2	Jump to EXEC to finish	
Process Sequential Instructions					
00FD	7E	Thrb	MOV A,M	Get first byte	
00FE	32 1C 01		STA INST	Store byte	
0101	23		INX H		
0102	7E	Twob	MOV A,M	Get byte	
0103	32 1D 01		STA INST+1	Store byte	
0106	23		INX H		
0107	7E	Oneb	MOV A,M	Get byte	
0108	32 1E 01		STA INST+2	Store byte	
010B	23		INX H		
010C	22 F1 01		SHLD STACK+14	Store PC value	
010F	2A EF 01		LHLD STACK+12	HL = SP value	
0112	31 F5 01		LXI SP, STACK+18		
0115	D1		POP D	DE = program value	
0116	CI		POP B	BC = program value	
0117	F1		POP PSW	A and flags = program value	
0118	F9		SPHL	SP = program value	
0119	2A F3 01		LHLD STACK+16	HL = program value	
011C	DS 3	Inst	DS 3	Execute instruction stored here	
011F	22 F3 01		SHLD STACK+16	Store HL	
0122	21 00 00		LXI H,O	HL = O	
0125	DA 2C 01		JC CARRY	Determine state of carry flag	
0128	39		DAD SP	HL = program SP value	
0129	C3 2E 01		JMP STOR		
012C	39	Carry	DAD SP	HL = program value	
012D	37		STC	Reset carry flag	
012E	31 FB 01	Stor	LXI SP, STACK+24		
0131	F5		PUSH PSW	Store A and flags	
0132	C5		PUSH B	Store BC	
0133	D5		PUSH D	Store DE	
0134	31 F1 01		LSI SP, STACK+14		
0137	E5	Stor1	PUSH H	Store SP value	
0138	3A E4 01	Stor2	LDA STACK+1	Load breakpoint mode indicator	
013B	A7		ANA A	Set flags	
013C	CA 54 01		JZ DSPY	Jump if not in breakpoint mode	
013F	2A F1 01		LHLD STACK+14	Load current PC value	
0142	3A E5 01		LDA STACK+2	Load lower byte of breakpoint address	
0145	BD		CMP L		
0146	C2 OA 00		JNZ NEXT	Jump if addresses not equal	
0149	3A E6 01		LDA STACK+3	Load lower byte of breakpoint address	
014C	BC		CMP H		
014D	C2 OA 00		JNZ NEXT	Jump if addresses not equal	
0150	AF		XRA A	A = O	
0151	32 E4 01		STA STACK+1	Breakpoint address reached, return to single step mode	
0154	21 FA 01	Dspy	LXI H,STACK+23	Load address of registers	
0157	E5		PUSH H		
0158	21 FD 01		LXI H, ASCII	Load address of headings	
015B	OE 06		MVI C, 6	C = loop count	
015D	06 03	Dspy1	MVI B, 3	B = output character count	
015F	CD 4D 02		CALL OUTPT	Output heading	
0162	E3		XTHL	Get register address	
0163	CD 2E 02		CALL CONV	Output register value	
0166	2B		DCX H		
0167	CD 2E 02		CALL CONV	Output register value	
016A	2B		DCX H		
016B	06 03		MVI B, 3	B = output character count	
016D	79		MOV A,C	Check loop count	
016E	1F		RAR		
016F	D2 74 01		JNC DSPY2	Jump if no CR output	
0172	06 04		MVI B, 4	Increase character count for CR	
0174	EB	Dspy2	XCHG		
0175	21 10 02		LXI H, SPACE	Load output address	
0178	CD 4D 02		CALL OUTPT		
017B	E1		POP H	Get heading address	
017C	D5		PUSH D	Store register address	
017D	23		INX H		
017E	OD		DCR C	Decrement loop count	
017F	C2 5D 01		JNZ DSPY1	Jump if not finished	
0182	D1		POP D	Get rid of address	
0183	D1		POP D	DE = SP value	
0184	E1		POP H	HL = PC value	
0185	E5		PUSH H		
0186	D5		PUSH D		
0187	D5		PUSH D		
0188	11 FA FF		LXI D, -6	HL = PC - 6	
018B	19		DAD D	C = loop count	
018C	OE OC		MVI C, OCH		
018E	EB		XCHG		
018F	21 10 02	Dspy3	LXI H, SPACE	HL = output address	
0192	79		MOV A, C	Check loop count	
0193	FE 06		CPI 6		
0195	C2 99 01		JNZ DSPY4	Jump if no asterisk output	
0198	2B		DCX H	Change address for asterisk	
0199	06 02	Dspy4	MVI B, 2	Load output count	
019B	CD 4D 02		CALL OUTPT		
019E	EB		XCHG		
019F	CD 2E 02		CALL CONV	Output PC value	
01A2	23		INX H		
01A3	EB		XCHG		
01A4	06 03		MVI B, 3	Load output count	
01A6	21 10 02		LXI H, SPACE		
01A9	CD 4D 02		CALL OUTPT	Output spaces	
01AC	E1		POP H	Get address of SP	
01AD	D5		PUSH D	Store address of PC	
01AE	CD 2E 02		CALL CONV	Output SP value	
01B1	23		INX H		

01B2	CD 2E 02		CALL CONV
01B5	23		INX H
01B6	D1		POP D
01B7	E5		PUSH H
01B8	06 01		MVI B, 1
01BA	21 13 02		LXI H, SPACE+3
01BD	CD 4D 02		CALL OUTPT
01CO	OD		DCR C
01C1	C2 8F 01		JNZ DSPY3
01C4	CD 5C 02		CALL INP
01C7	FE 42		CPI 'B'
01C9	C2 DD 01		JNZ CONT
01CC	32 E4 01		STA STACK+1
01CF	CD 15 02		CALL LOC
01D2	22 E5 01		SHLD STACK+2
01D5	21 13 02		LXI H,SPACE+3
01D8	06 01		MVI B, 1
01DA	CD 4D 02		CALL OUTPUT
01DD	2A F1 01	Cont	LHLD STACK+14
01EO	C3 OA 00		JMP NEXT

Register Storage

01E3	Stack	DS 26	Reserve 26 bytes for STACK
------	-------	-------	----------------------------

ASCII Headings

01FD	41 20	Ascii	DW 'A '
01FF	3D 42		DW '=B'
0201	43 3D		DW '=C'
0203	44 45		DW '=DE'
0205	3D 48		DW '=H'
0207	4C 3D		DW '=L'
0209	50 43		DW '=PC'
020B	3D 53		DW '=S'
020D	50 3D		DW '=P=
020F	2A		DB '*'
0210	20	Space	DB ','
0211	20 20		DW ' '
0213	OD OA		DW ODOAH

This Routine gets a Four Digit ASCII Address from an Input Device, Converts to Hex and Returns with Value in HL

0215	06 04	Loc	MVI B, 4	Load loop count
0217	CD 5C 02	Loc1	CALL INP	Get character
021A	29		DAD H	Shift HL four places
021B	29		DAD H	
021C	29		DAD H	
021D	29		DAD H	
021E	FE 40		CPI 40	Convert to hex
0220	DA 25 02		JC LOC2	Jump if number
0223	C6 09		ADI 9	Add bias to letter
0225	E6 OF	Loc2	ANI OFH	Strip off upper bits
0227	B5		ORA L	
0228	6F		MOV L, A	Move to HL register
0229	05		DCR B	Decrement loop count
022A	C2 17 02		JNZ LOC1	
022D	C9		RET	

This Routine Converts the Byte Pointed to by HL from Hex to ASCII and Outputs the two Digits

022E	16 02	Conv	MVI D,2	Load loop count
0230	7E		MOV A,M	Get byte
0231	5F		MOV E,A	Store in E
0232	OF		RRC	Shift A four times
0233	OF		RRC	
0234	OF		RRC	
0235	OF		RRC	
0236	E6 OF	Conv1	ANI OFH	Mask out upper bits
0238	FE OA		CPI OAH	
023A	DA 3F 02		JC CONV2	Jump if number
023D	C6 07		ADI 7	Add bias for letter
023F	C6 30	Conv2	ADI 30	Add bias for ASCII
0241	77		MOV M,A	Store character in memory
0242	04		INR B	B = 1
0243	CD 4D 02		CALL OUTPT	Output character
0246	7B		MOV A,E	Move character to A
0247	15		DCR D	Decrement loop count
0248	C2 36 02		JNZ CONV1	Jump if not finished
024B	73		MOV M,E	Restore character to memory
024C	C9		RET	

This Routine Outputs a String of Characters, B = Number of Characters, HL Points to the Characters

024D	DB 02	Outpt	IN 2	Get status
024F	17		RAL	
0250	DA 4D 02		JC OUTPT	Jump if not ready
0253	7E		MOV A,M	Get output character
0254	D3 03		OUT 3	Output character
0256	05		DCR B	Decrement loop count
0257	C8		RZ	Return if done
0258	23		INX H	Advance pointer
0259	C3 4D 02		JMP OUTPT	

This Routine Inputs one Character

025C	DB 02	Inp	IN 2	Get status
025E	OF		RRC	
025F	DA 5C 02		JC INP	Jump if not ready
0262	DB 03		IN 3	Get character
0264	C9		RET	

digit hex starting address. The simulator then executes the first instruction and displays the result. The display contains 15 lines, and since my TV typewriter has 16 lines (most systems will need a line feed) a CR returns the cursor to the top of the next page. The simulator interprets the keyboard input as a signal to go ahead and execute the next instruction and output the results. To go into breakpoint mode type a B followed by a four digit hex address. The simulator will continue to execute instructions without display until it comes to the breakpoint address and then revert to single-step mode to display the registers and wait for an input.

Nearly every program must be tailored to the individual system on which it runs. Most users will probably need a CR followed by a line feed to return the cursor or printhead to the beginning of the next line. If this is the case with your system, increment the size of the constants in the MVI B instructions at 172, 1B8 and 1D8. All the input and output routines are at the end of the program so you can easily incorporate other routines such as those used in a monitor, or change the I/O to octal format.

When using the simulator even in breakpoint mode remember the program is being executed at a much slower speed than if it were running alone. Certain real-time applications such as routines with high speed peripherals may not operate properly. Several times I've had a program work using the simulator but fail when run by itself. Every time the problem has been traced to a defective memory chip. When run at full speed as during a stack operation, the memory picked a bit; but when the time between certain memory accesses was changed under the simulator, it worked.

I have found the simulator to be an invaluable troubleshooting tool and believe you will too. ■

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Build a \$20 EPROM Programmer

... for the 5204 4K chip

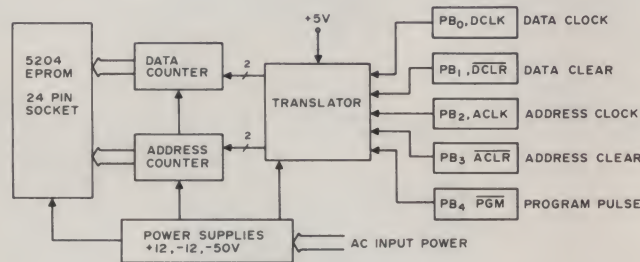


Fig. 1a. Programmer block diagram.

PBDD = ***11111, * = don't care, PBDD = 1F
PB₀ = DCLK Clocks data on positive edge ↑ each transition increments the data.
PB₁ = DCLR Clears data to zero on low level. Normally high.
PB₂ = ACLK Clocks address on positive going edge ↑ each transition increments the address.
PB₃ = ACLR Clears address to zero on low level. Normally high.
PB₄ = PGM Provides program pulse to EPROM on low level. Normally high.

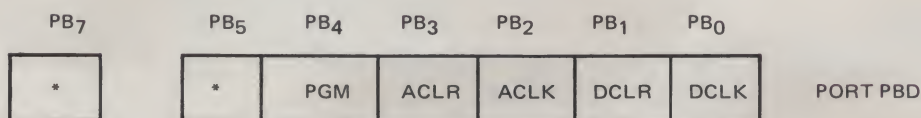


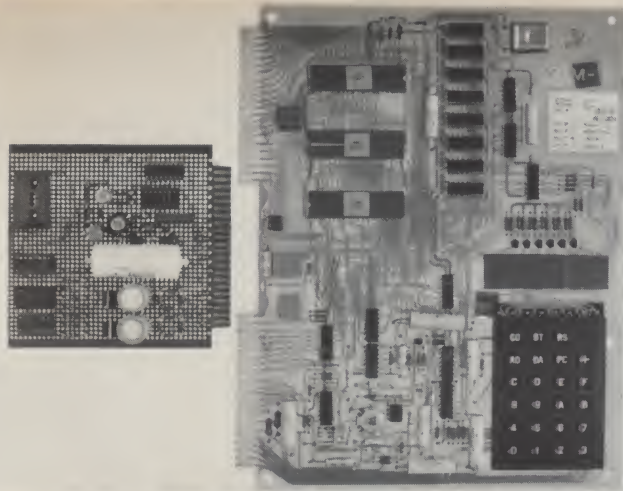
Fig 1b. KIM-1 port assignments.

The availability of low-cost electrically programmable read only memory (EPROM) and the convenience of having a few favorite routines permanent as ROM in my KIM system provided the motivation to construct a 5204 EPROM programmer extension for KIM. The programmer design was to be as simple as possi-

ble, minimize I/O pin usage, and have its software completely relocatable to allow the routine to install itself in EPROM and be located in KIM unused memory areas without alteration. To reduce the programmer hardware requirement, the decision was made not to read the EPROM during programming as do most commercial programmers. The read EPROM modification to hardware and software could be added later should the need arise. Normally an EPROM will be programmed and then changed to a memory socket in KIM to be tested. Fig. 1a is a block diagram of the programmer and Fig. 1b details the KIM-1 port assignments for interfacing to the programmer.

Why the 5204 EPROM?

The 5204 EPROM by



KIM-1 and programmer board - a neat combination.

National Semiconductor (MM5204) is a 4K electrically programmable (and erasable) read only memory. The device is a non-volatile memory organized 512×8 ($\frac{1}{2}$ K bytes per chip). The 5204 requires +5 and -12 volt power supplies for ROM operation. Additional noteworthy features are its typical access time of 750 ns typical (1μ s maximum), power saver control for low power applications, and a three state data bus which permits easy memory expansion.

An alternative to the 5204 would be the readily available and inexpensive 1702A EPROM. The 1702A is organized 256×8 or $\frac{1}{4}$ K bytes. Its access time is 1μ s maximum, identical to the 5204. The cost of a 1702A is about \$7 as compared to \$8 for the 5204. An immediate observation is the smaller cost

per EPROM byte with the 5204. Naturally, if your requirements call for smaller memory blocks, such as a small system application, the 1702A may be a better choice. The 1702A is slightly more difficult to program due to the requirement to complement addressing during programming. This feature could be easily added to my basic programmer if you chose to modify it for the 1702A. The 1976 Intel Data Catalog is a good reference for the 1702A description and programming.

To access slow memory (access time less than 500 ns) with the 6502 a wait cycle is usually forced during memory read or write. The *MCS6500 Microcomputer Hardware Manual* by MOS Technology, Inc. describes a simple circuit to accomplish this wait cycle in section

2.3.4.1. By experimentation, however, I found that the combination of the 6502 having the address valid extended periods and the typical access time for the 5204 of 750 ns this delay circuit could be deleted. The 5204 EPROM has allowed me to expand KIM -1 with inexpensive ROM without affecting processor speed.

Programming the 5204 EPROM

Much of the literature I dug into discussed programming of the 1702A, 2708, and the 5204. The general consensus seems to be to not apply excessive voltages to prevent catastrophic failures, not to apply extremely fast waveforms to the address and data lines to prevent capacitive coupling internally from damaging the device, and not to apply excessively high duty cycle waveforms during programming to prevent high power dissipation in the device.

One good source of information is the *PROM User's Guide* published by Prolog

Corporation. Specific information on the 5204 EPROM may be obtained from National Semiconductor's MOS IC Data Book. Although some conflicting information is in these publications, the general guide lines were followed and in turn, good results obtained. For example, the first National MOS book I used indicated the program pulse width should be between 2.5 ms and 5 ms with a duty cycle of less than 25%. With this data in hand I selected a 3 ms program pulse, an off time of 10 ms, and a 23% duty cycle (see Fig. 2). In a later MOS memory publication National specifies the minimum pulse width as .5 ms. I saw no real reason to alter the timing, however, you may want to save time by adjusting the pulse timers in the routine. All you need do is scale down both times by an equal factor. A word of caution is in order though; be aware that the off period will be affected with less than 4.08 ms (1 MHz clock) off time although the programmer will still operate.

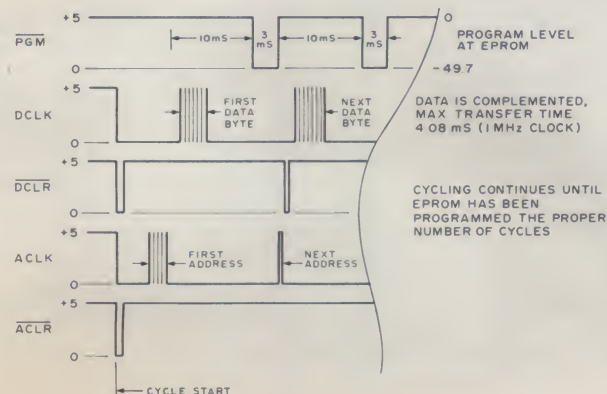


Fig. 2. Programmer timing diagram.

Sockets

- 1 24 pin dip
- 2 14 pin dip
- 3 16 pin dip

Miscellaneous

- 1 $4\frac{1}{2}$ " square, .1 inch center, Vero or Vector board
- 1 44 pin edge connector (use with Vero board)
- 60 component mounting pins

Discretes

- 2 100 Ohm 1% $\frac{1}{4}$ W
- 1 1k Ohm 10% $\frac{1}{4}$ W
- 4 15k Ohm 10% $\frac{1}{4}$ W
- 1 10k Ohm 10% $\frac{1}{4}$ W
- 2 2.7k Ohm 10% $\frac{1}{4}$ W
- 1 5.6k Ohm 10% $\frac{1}{2}$ W
- 9 100k Ohm 5% $\frac{1}{4}$ W
- 1 100 pF disk cap
- 2 1.0 uF 50 volt monolithic cap
- 1 10k Ohm trimpot
- 8 IN4002 rectifier
- 1 12 volt, 1 Watt Zener diode
- 1 2N2905A PNP transistor or eq.
- 1 2N5287 PNP transistor or eq. (with heat sink)
- 1 2N1893 NPN transistor or eq.
- 2 500 uF 35 volt electrolytic cap
- 1 100 uF 75 volt electrolytic cap
- 1 7812 +12 volt regulator
- 1 7912 -12 volt regulator
- 1 uA723 precision regulator
- 2 4040 CMOS counter
- 1 LM3900 Op amp
- 1 4050 CMOS buffer
- 2 25.2 VCT transformer (Stancor P8180)

Table 1. Parts list.

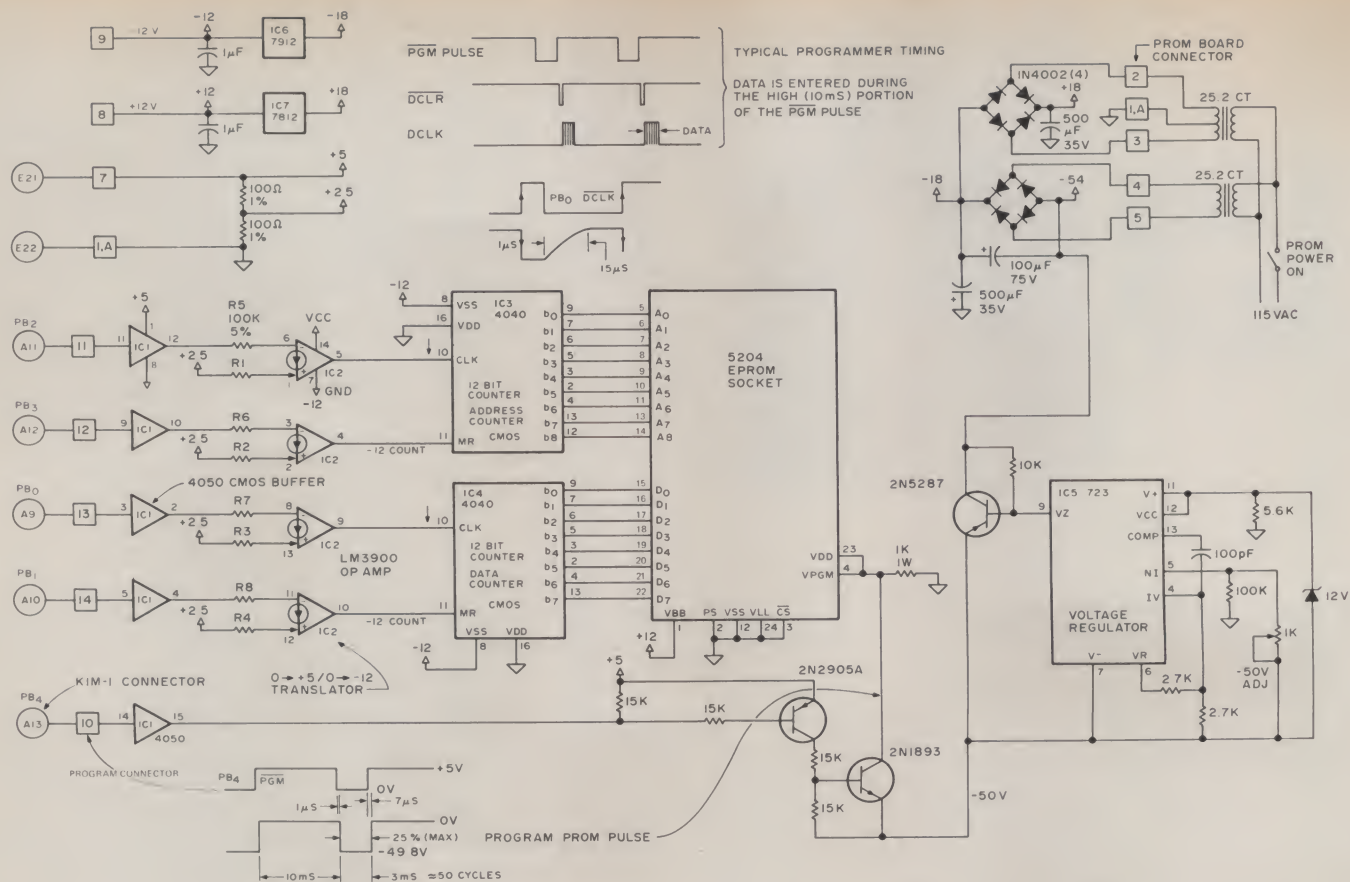


Fig. 3. Schematic diagram of 5204 EPROM Programmer.

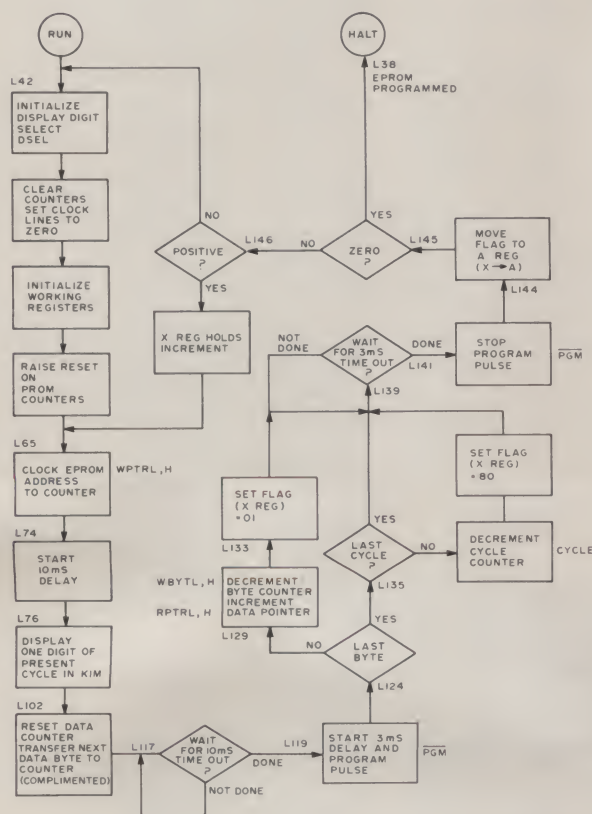


Fig. 4. EPROM Programmer flow diagram.

National suggests the 5204 be overprogrammed sequentially. Overprogramming consists of programming the EPROM in excess of the number of program cycles actually required to establish the correct data pattern. National states that each address location must be programmed for a minimum of 32 cycles with a pulse width of 5 ms or 64 cycles as the pulse width reaches 2.5 ms. I selected 50 cycles for a pulse width of 3 ms. For shorter program pulse widths National notes the EPROM should be programmed until the correct pattern is read back and then overprogrammed five times. This is symbolized by the notation $x + 5x$ in the National literature. Since my programmer does not read this EPROM during programming the number of cycles are fixed by the routine or the operator at initialization.

The results of the tech-

nique used here have been satisfying and successful. To date I have 100% programmed a dozen EPROMS without a problem, except for one defective EPROM, which was replaced by the supplier at no charge.

The Programmer Circuit

The circuit shown in Fig. 3 contains three regulator circuits with rectifiers for providing +12, -12, and -50 volts for the programmer. The 4040 CMOS counters provide the EPROM data and address registers. The LM3900 quad op amp translates the KIM 5 volt logic to -12 volt logic to control the counters. Two transistors level shift the program pulse to -50 volts. The third transistor is a series element in the uA723 -50 volt negative voltage regulator circuit. The 4050 CMOS buffer was used to convert the KIM TTL outputs to CMOS to gain the additional voltage swing pro-

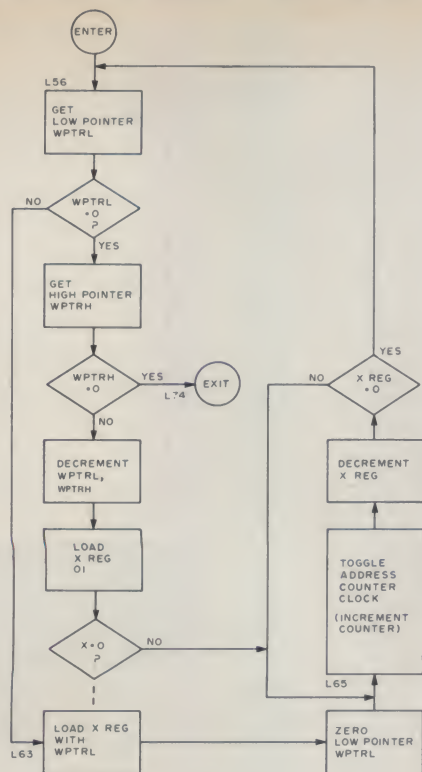


Fig. 5. Increment EPROM address routine flowchart.

vided with CMOS for increased reliability in the voltage translation process.

The address and data counters are operated identically. The counter is reset and then clocked until it contains the proper bit pattern for programming. The address is initialized and incremented to the cycle end. The data counter has the proper data pattern toggled in after being complemented by the programmer routine. The 5204 requires complemented data during programming.

Construction

My board is constructed on a 4½" x 4½" Vero board which was cut down from a standard 4½" x 6" 44 pin Vero proto board (#10290/FG W44/74). The sockets and components used were non-critical; however, the EPROM socket should be a type that allows the EPROM easy entry and removal. Most economical sockets will fill the requirement. A zero force type socket that is used on commercial programmers would be ideal and expensive.

A standard Augat wire-wrap socket (Augat #324-AG2F) works fine. It all depends if you're going to program thousands of EPROMs. If you are, you should probably purchase one of the zero

force type sockets.

The circuit board power supply rectifiers and regulators are shown in the photos. The transformers, which came from my scrap pile, are mounted adjacent to the card support. The discrete components are all parts which were readily available and are non-critical in nature. The only requirements on the transistors are that they have a breakdown voltage in excess of 50 volts and be capable of dissipating a couple of Watts. The -50 volt regulator series pass transistor should have a small heatsink. If one is not available, fabricate one out of a thin sheet of copper or aluminum.

The complete parts complement should cost about \$20 excluding EPROMs.

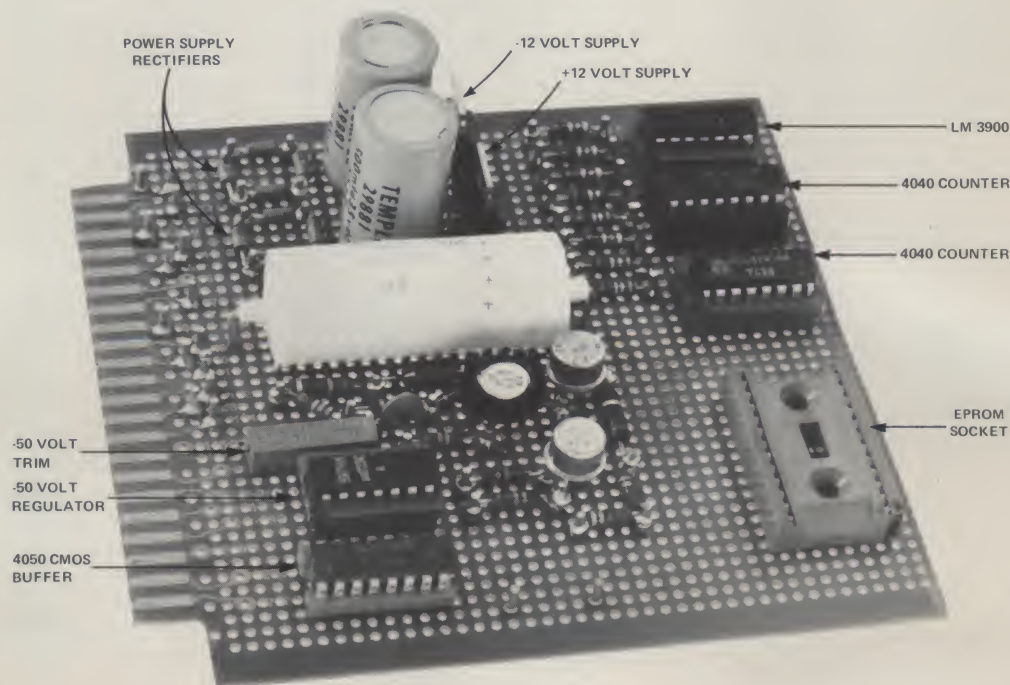
About the Program

The first usage of the program was to program an EPROM with itself to allow the EPROM routine to reside in KIM memory as ROM. I also felt that the program would serve more systems if it is independent of where it resides. You may, for instance want to relocate it

from a cassette into different portions of RAM so as not to disturb the program you want to enter into EPROM.

The programmer routine runs in two sections (see Fig. 4 and 5 and Program A). The first section, beginning with EPROM start, does a little housekeeping and then halts allowing the insertion of the EPROM in the programmer socket. The routine tests the number of bytes to be programmed; if the count is correct, it enters the number of bytes to be programmed into a counter. If the count is incorrect (i.e., if the number of bytes to be programmed is less than zero or greater than ½K), the routine exits to display FFFF in the KIM monitor. Then the break vector is established, the number of cycles is set to 50, and the I/O port to the programmer is initialized. After this the programmer routine halts in the KIM monitor at the first instruction in the next section (run, L42) of the routine.

The halt allows power down of the programmer to permit the EPROM to be installed in the socket. Power



5204 EPROM Programmer board.

- A. Turn off EPROM power
- B. Enter memory source start address
- C. Enter memory source stop address
- D. Enter EPROM destination start address
- E. Start program at start address

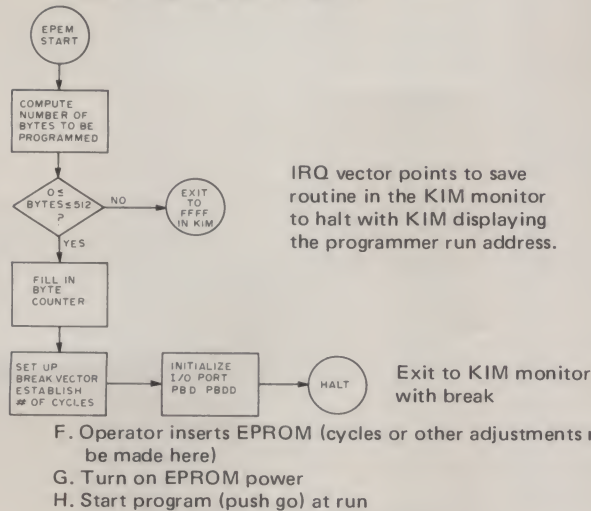


Fig. 6. Running the programmer.

is then restored and the EPROM may now be programmed. Running the routine, at the RUN location, programs the EPROM. While this program runs the present cycle is displayed in the KIM data digits, in hexadecimal, with the address digits dark. When finished the routine halts again at the RUN address. The programmer may now be powered down and the programmed EPROM removed.

The heart of the programmer routine, the RUN section, initializes the counters on the programmer for

address and data entry. The address is entered to the programmer followed by the programmer 10 ms pulse. During this delay one of the digits of the cycle is displayed and the data is transferred from the RAM byte specified to the EPROM data counter. The routine then waits for the end of the 10 ms period.

At the end of the 10 ms period, the programmer program pulse is started along with the on period time of 3 ms. During this period the routine establishes the next operation by setting pointers

to the next byte of data or cycle through the setting of a flag in the x register. With the termination of the 3 ms period the programmer pulse is turned off, the flag is tested, and the next operation is performed. The operation consists of getting the next byte of data, starting a new cycle, and performing a halt when the EPROM is programmed.

An interesting note is the time consuming loop that clocks the data to the EPROM programmer data counter. Because this loop is completed during the off period of the programmer pulse the time period to program an EPROM is independent of this loop. This technique is an excellent example of how to use the KIM timer and the advantage of such a timer in a microcomputer system. The computer may do other tasks during waiting periods as long as you're back within the time period. With KIM the timer can easily be programmed to interrupt should uncertainties develop in the time required to complete the assigned tasks. Also, since the cycle digit is displayed during this 10 ms period, the digit stays on until the next 10 ms period is entered or the routine halts.

Operation

Operator loads via KIM

keyboard the start read, end read, and start write address in page zero. The power to the programmer circuit should be turned off, EPROM removed. (Refer to Fig. 6.)

Operator starts the program at the start (first instruction). At this time the program computes the number of bytes to be programmed, sets up the IRQ vector for a program stop on break to KIM, establishes the number of programmer cycles, (which may be changed when the program halts) establishes the I/O configuration for the programmer, and then halts with the run address displayed by the KIM monitor.

The program will exit to FFFF in KIM if more than 512 bytes are selected to be written or if less than zero bytes were selected.

When the program halts, the number of cycles may be altered if desired.

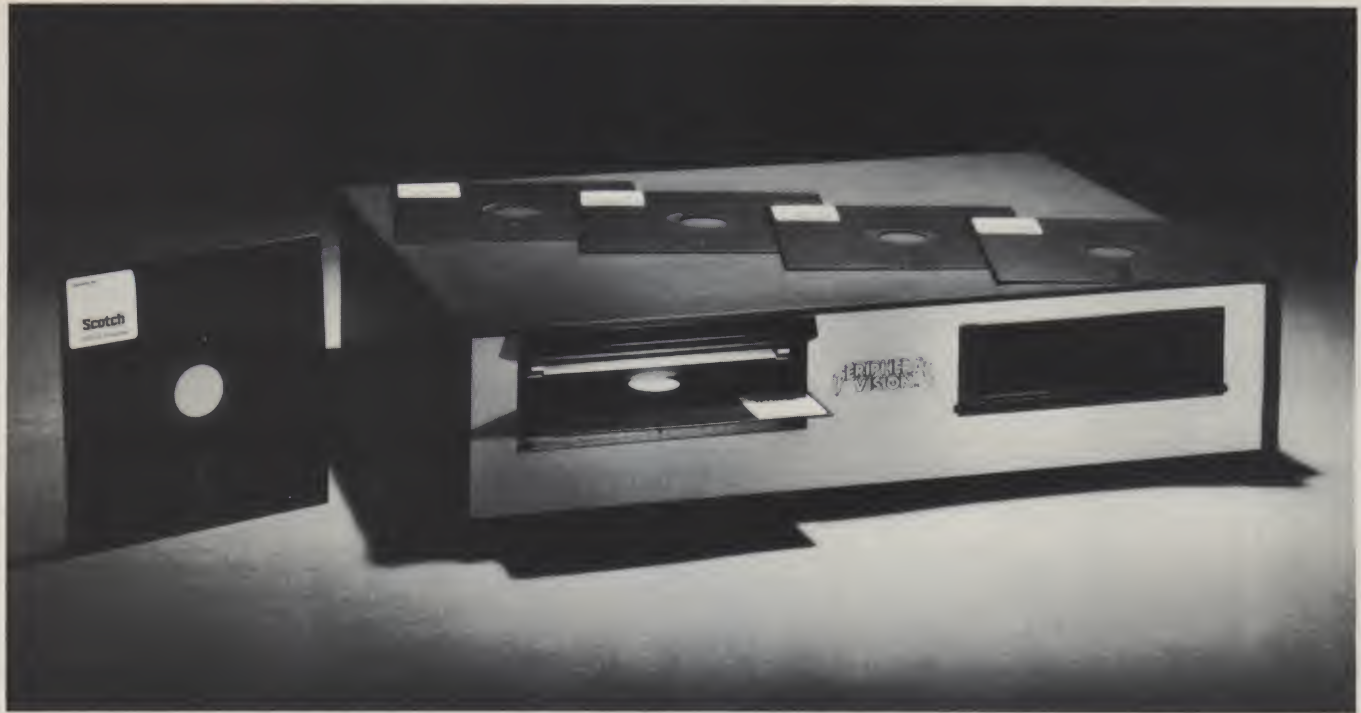
The next step is to plug a 5204 EPROM into the programmer socket, turn on the programmer power, and then start the program (push go at the displayed address; run).

The cycles are counted down and displayed in the KIM display (in hexadecimal). The program halts back at the run address. Turn off the programmer, remove the programmed EPROM. ■

Program A. 5204 EPROM Programmer software routine (continued on page 76).

Page Zero Registers			
Cycle and Display Counters			
00DF	DSEL		DISPLAY DIGIT SELECT CODE
00E0	CYCLE		NUMBER OF PROGRAM CYCLES
Instruction Data			
00E1	ERAL		END READ ADDRESS LOW
00E2	ERAH		END READ ADDRESS HIGH
00E3	SRAL		START READ ADDRESS LOW
00E4	SRAH		START READ ADDRESS HIGH
00E5	SWAL		START WRITE ADDRESS LOW
00E6	SWAH		START WRITE ADDRESS HIGH
Working Registers			
00E7	BYTL		NUMBER OF PROGRAM LOW BYTES
00E8	BYTH		NUMBER OF PROGRAM HIGH BYTES
00E9	RPTRL		NEXT BYTE POINTERS
00EA	RPTRH		FOR DATA SOURCE
00EB	WPTRL		WRITE POINTERS FOR EPROM
00EC	WPTRH		ADDRESS START
00ED	WBYTL		BYTE COUNT WORKING REGISTERS
00EE	WBYTH		
Initialize routine: Establish data pointers, check for number of bytes $0 \leq \text{bytes} \leq 512$ establish cycles, stop at program EPROM start address			
0200	D8		START PROGRAM
0201	38		DETERMINE NUMBER
0202	A5	E1	OF BYTES
0204	E5	E3	TO
0206	85	E7	BE
	EPGM	CLD	
		SEC	
		LDA	ERAL
		SBC	SRAL
		STA	BYTL

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- Interface card design is licensed from Dr. Kenneth Welles and the Digital Group
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Power supply—+24V at 2A	45	65
Cabinet—Optima, blue	—	85

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0208	A5	E2			LDA	ERAH	PROGRAMMED
020A	E5	E4			SBC	SRAH	
020C	10	03			BPL	L26	TEST IF NEGATIVE
020E	4C	29	19	L25	JMP	FFFF	SOMETHINGS WRONG, EXIT
0211	C9	02		L26	CMP	02	TEST IF \geq 512
0213	10	F9			BPL	L25	EXIT IF POSITIVE (02 OR MORE)
0215	85	E8			STA	BYTH	ELSE, STORE
0217	18				CLC		
0218	A9	00			LDA	00	SET UP
021A	8D	FE	17		STA	17FE	BREAK
021D	A9	1C			LDA	1C	VECTOR
021F	8D	FF	17		STA	17FF	TO POINT AT STOP ROUTINE
0222	A9	31			LDA	31	INITIALIZE NUMBER
0224	85	E0			STA	CYCLE	OF CYCLES TO 50
0226	A9	1F			LDA	1F	ESTABLISH OUTPUT
0228	8D	03	17		STA	PBDD	PORT AND
0223	A9	10		STOP	LDA	10	SET OUTPUT
022D	8D	02	17		STA	PBD	STATUS
0230	00				BRK		BREAK WITH (RUN)
0231	00						NEXT ADDRESS IN KIM
Program EPROM routine, initialize routine stops at run for EPROM setup in programmer circuit							
0232	A9	00			LDA	00	INITIALIZE
0234	85	DF			STA	DSEL	DIGIT SELECT
0236	A9	F0			LDA	F0	CLEAR COUNTERS
0238	2D	02	17		AND	PBD	READY CLOCKS
023B	8D	02	17		STA	PBD	
023E	A2	06			LDX	06	RESTORE
0240	B5	E2		L48	LDA	L4,X	WORKING
0242	95	E8			STA	L10,X	REGISTERS
0244	CA				DEX		
0245	D0	F9			BNE	L48	
0247	A9	0A			LDA	0A	RAISE RESETS
0249	0D	02	17		ORA	PBD	ON
024C	8D	02	17		STA	PBD	COUNTERS
024F	A0	00			LDY	00	ZERO Y (X = 0)
0251	A5	EB		L56	LDA	WPTRL	GET LOW POINTER FOR INCREMENT
0253	D0	0C			BNE	L63	IF NOT ZERO INCREMENT COUNTER
0255	A5	EC			LDA	WPTRH	
0257	F0	21			BEQ	L74	EXIT IF ZERO
0259	C6	EB		L60	DEC	WPTRL	ELSE, INCREMENT
025B	C6	EC		L60A	DEC	WPTRH	TO NEXT
025D	A2	01		L61	LDX	01	PAGE
025F	D0	04			BNE	L65	
0261	A6	EB		L63	LDX	WPTRL	
0263	84	EB			STY	WPTRL	ZERO WPTRL
0265	A9	FB		L65	LDA	FB	ENTER HERE FOR 1 STEP
0267	2D	02	17		AND	PBD	WITH X = 01
026A	8D	02	17		STA	PBD	
026D	A9	04			LDA	04	
026F	0D	02	17		ORA	PBD	
0272	8D	02	17		STA	PBD	
0275	CA				DEX		
0276	D0	ED			BNE	L65	
0278	F0	D7			BEQ	L56	
Start 10 ms delay, display cycle digit							
027A	A9	9C		L74	LDA	9C	START 10ms DELAY
027C	8D	06	17		STA	64	(1706)
027F	A9	7F			LDA	7F	SET UP SEGMENT PORT
0281	8D	41	17		STA	PADD1	FOR OUTPUT
0284	8E	40	17		STX	PAD1	X = 0 FROM ABOVE, SEGMENTS OUT
0287	8E	42	17		STX	PBD1	TURN OFF DIGIT
028A	A5	DF			LDA	DSEL	SELECT DIGIT TO BE DISPLAYED
028C	D0	13			BNE	L91	BRANCH TO DISPLAY HIGH DIGIT
028E	A9	12			LDA	DIG 1	LOAD 12 FOR LOW DIGIT
0290	8D	42	17		STA	PBD1	SELECT DIGIT
0293	A9	0F			LDA	0F	
0295	25	E0			AND	CYCLE	GET LOW DATA
0297	E6	DF			INC	DSEL	SELECT NEXT DIGIT
0299	D0	13			BNE	L99	ALWAYS NOT EQUAL TO ZERO
029B	F0	8E		STOP 1	BEQ	STOP	INTERMEDIATE STOP BRANCH
029D	10	C6		L89	BPL	L65	INTERMEDIATE BRANCH
029F	30	91		RUN 1	BMI	RUN	INTERMEDIATE RUN BRANCH
02A1	A9	10		L91	LDA	DIG2	LOAD 10 FOR HIGH DIGIT
02A3	8D	42	17		STA	PBD1	SELECT DIGIT
02A6	A5	E0			LDA	CYCLE	GET HIGH
02A8	4A				LSR		DIGIT
02A9	4A				LSR		OF CYCLE DATA
02AA	4A				LSR		
02AB	4A				LSR		
02AC	C6	DF			DEC	DSEL	
02AE	A8			L99	TAY		
02AF	B9	E7	1F		LDA	ABS, Y	GET CONVERSION DATA
02B2	8D	40	17		STA	PADD	TURN ON SEGMENTS
Get data byte to EPROM data counter, wait for end of 10 ms pulse, start 3 ms EPROM program pulse							
02B5	A9	FD			LDA	FD	RESET DATA COUNTER
02B7	2D	02	17		AND	PBD	
02BA	8D	02	17		STA	PBD	

02BD	A9	02	
02BF	0D	02	17
02C2	8D	02	17
02C5	A9	FF	
02C7	A0	00	
02C9	51	E9	
02CB	F0	0A	
02CD	AA		
02CE	EE	02	17
02D1	CE	02	17
02D4	CA		
02D5	D0	F7	
02D7	AD	07	17
02DA	F0	FB	
02DC	A9	30	
02DE	8D	06	17
02E1	A9	EF	
02E3	2D	02	17
02E6	8D	02	17

*Test for last byte, last cycle, wait
for 3 ms time-out. Stop program pulse*

02E9	E4	ED	
02EB	D0	06	
02ED	E4	EE	
02EF	F0	0E	
02F1	C6	EE	
02F3	C6	ED	L129
02F5	E6	E9	
02F7	D0	02	
02F9	E6	EA	
02FB	A2	01	L133
02FD	D0	08	
02FF	E4	E0	L135
0301	F0	04	
0303	C6	E0	
0305	A2	80	
0307	AD	07	17
030A	F0	FB	L139
030C	A9	10	
030E	0D	02	17
0311	8D	02	17
0314	8A		
0315	F0	84	
0317	10	84	
0319	30	84	

LDA	02
ORA	PBD
STA	PBD
LDA	FF
LDY	00
EOR	(IND),Y
BEQ	L117
TAX	
INC	PBD
DEC	PBD
DEX	
BNE	L113
LDA	1707
BEQ	L117
LDA	30
STA	-64
LDA	EF
AND	PBD
STA	PBD

GET COMPLEMENTED
DATA
FOR COUNTER RPTRL
EXIT IF DATA IS ZERO
ELSE INCREMENT COUNT

(4.08ms LOOP MAX WITH 1 MHz CLOCK)

GET TIMER STATUS
IF NOT DONE, CHECK
START 3ms TIME
FOR PROGRAM PULSE

START PULSE

CPX	WBYTL
BNE	L129
CPX	WBYTH
BEQ	L135
DEC	WBYTH
DEC	WBYTL
INC	RPTRL
BNE	L133
INC	RPTRH
LDX	01
BNE	L139
CPX	CYCLE
BEQ	L139
DEC	CYCLE
LDX	80
LDA	1707
BEQ	L139
LDA	10
ORA	PBD
STA	PBD
TXA	
BEQ	STOP1
BPL	L89
BMI	RUN1

BOTH ZERO BRANCH TO TEST CYCLE

SET FLAG AND WAIT
FOR TIME OUT, FLAG = 01, POS

WAIT FOR TIME OUT FLAG = 00

TEST FOR TIME OUT

STOP PROGRAM
PULSE

GET FLAG FOR TEST
IF ZERO, ALL DONE, EXIT AT START
BRANCH IF POSITIVE TO INC. ADDRESS
RUN NEXT CYCLE

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Faster MIKBUG Load Technique

... uses binary format

Tired of waiting five to ten minutes to load that assembler or BASIC? With this program you can cut that load or dump time by more than fifty percent.

In the PUNCH (write data to cassette) and LOAD (read data from cassette) routines of the MIKBUG monitor, two-byte ASCII characters are used to represent one byte of data. This requires 50% more time to punch/load

than is really necessary. MIKBUG also produces records containing a maximum of 16₁₀ data bytes. This is inefficient (with regard to speed) since each record, regardless of length, requires ten bytes of overhead (two header bytes, two size bytes, four address bytes and two checksum bytes).

How do we improve on this? First we don't record ASCII characters, we record

the whole byte just the way it is, in binary. It will look like a lot of garbage when it comes out on the terminal, but we don't need it anyway. Second, we don't output just 16₁₀ bytes per record; we use 255 bytes per record.

We can see this a little better by referring to Table 1. The memory address and contents are shown in the first two columns. In order to save the data between lo-

cation 0100 and 0111 MIKBUG will require two data records. It will require a total of 56₁₀ bytes of information to save this data. The binary routines, however, require only one data record and a total of 23₁₀ bytes of information to save the same data. The main difference between the two formats is that MIKBUG converts each data byte into its equivalent ASCII form; whereas, the binary routines simply transfer the data bytes in their original *binary* form (hence the name Binary Punch/Loader). This is what makes the output unreadable on an ASCII device.

The other advantage of the binary routines over MIKBUG is that MIKBUG limits its record length to 16₁₀ data bytes. The binary routines are limited by the eight-bit byte (or rather, the highest count which can be obtained with eight bits) which is FF₁₆ or 255₁₀ data bytes. With the binary routines there is a six-byte overhead for each record of 255₁₀ data bytes; whereas, MIKBUG has a ten-byte overhead for each record of 16₁₀ data bytes.

I have found it best to use this new binary format as a complement to, rather than a replacement for the MIKBUG format. The main reason is that the MIKBUG format is well-established and widespread with many programs available in this format. I simply load these programs using MIKBUG, then save them on another tape in the binary format. This allows for faster loading the next time I wish to run the program. Since the two formats are not compatible with each other it is necessary to identify on the cassette which is in MIKBUG and which is in binary format, but since each tape contains a copy of the binary loader (in MIKBUG) there is no problem of incompatibility at load time.

Punch — New Version

Before we can load a program with this method, we

		MIKBUG Record(Hex)	ASCII Output	Binary Record(Hex)
Header Byte		52 31	S1	58 31
Byte Count		31 33	13	12
Begin Address		30 31 30 30	0100	01 00
Address	Contents			
0100	21	31 31	21	21
0101	35	33 35	35	35
0102	F0	46 30	F0	F0
0103	A5	41 35	A5	A5
0104	94	39 34	94	94
0105	68	36 38	68	68
0106	73	37 33	73	73
0107	52	35 32	52	52
0108	25	32 35	25	25
0109	F1	46 31	F1	F1
010A	A0	41 30	A0	A0
010B	33	33 33	33	33
010C	FF	46 46	FF	FF
010D	0F	30 46	0F	0F
010E	E0	45 30	E0	E0
010F	12	31 32	12	12
Checksum		35 36	56	
Header Byte		52 31	S1	
Byte Count		30 35	05	
Begin Address		30 31 31 30	0110	
0110	01	30 31	01	01
0111	00	30 30	00	00
Checksum		45 38	E8	C1
Total Bytes Output		56		23

Table 1. MIKBUG versus binary format.

first have to write one to tape. We do this with the PUNCH BINARY program shown in Program 1. To make things easier at load time the first thing we want to do is save the start address of the program.

Lines 50-130 ask for and save the start address of the program. This address will be put in location A048-A049 at load time.

Lines 140-190 clear the screen, print directions, and prompt with an @ for the beginning and end memory locations to be saved.

Lines 200-290 set the number of bytes for the record and check for the end address.

Lines 300-330 generate the header for each record.

Line 340 clears the checksum.

Lines 350-360 write the number of bytes in the record.

Lines 370-390 write the start address of the record.

Lines 400-430 write each byte of the record.

Lines 440-470 write the checksum for the record.

Lines 480-500 check to see if all is finished; if not go back to PUN11 and start the next record. If all is done, go back to START. If we want to save another block of memory, enter the begin and end address of this new block. If we are finished, switch the AC-30 cassette interface to the local mode and enter X9. This is the end of file record.

Lines 510-560 is the sub-routine to add the next byte to the checksum, output the byte, via OUTEE, and increment the index register for the next byte.

Now the program is saved on tape. To read it back into memory, the LOAD BINARY program (Program 2) is used.

Load - New Version

Lines 1040-1110 read the tape and look for a header record. If it finds an end of file record (X9), processing is

complete and control is transferred to the monitor. If it finds a data record (X1), processing continues at BL1. Line 1120 clears the checksum.

Lines 1130-1140 read in the byte count for this record.

Lines 1150-1180 read in the start address for this record.

Lines 1190-1260 read in and check each of the data bytes. If an error occurs in storing

the data, a branch is made to BL3 to abort processing.

Lines 1270-1290 read in and check the checksum. If an error has occurred, processing is terminated.

Line 1300 transfers control back to the monitor if an error has occurred.

Lines 1310-1370 is a sub-routine to read in one data byte and update the checksum.

Lines 1380-1560 is a sub-routine to replace the MIKBUG "INEE". It is required since the MIKBUG routine masks out the high order bit when it reads in an ASCII character. We want to retain this bit because we are using the whole byte.

Lines 1570-1580 define three bytes of storage; one for the checksum and two for the start address of the record.

010		NAM	PUNCH BINARY	
020		OPT	O.S	
030		ORG	\$1E00	
040	BEGIN	LDS	#\$A047	move stack
050		LDX	#\$DIR	print request
060		JSR	\$E07E	PDATA1
070		JSR	\$E047	BADDR get start address
080		STX	\$A048	store
090		LDX	#\$A048	load this address
100		STX	\$A002	as begin location
110		LDX	#\$A049	load this address
120		STX	\$A004	as end location
130		BRA	GO	go write this to tape
140	START	LDX	#\$CLR	home,clear,prompt with "@"
150		JSR	\$E07E	PDATA1
160		JSR	\$E047	BADDR get begin location
170		STX	\$A002	
180		JSR	\$E047	BADDR get end location
190		STX	\$A004	
200	GO	LDX	\$A002	move begin address
210		STX	\$A00F	to temp
220	PUN11	LDAA	\$A005	check for end
230		SUBA	\$A010	location to
240		LDAB	\$A004	see if we
250		SBCB	\$A00F	can write
260		BNE	PUN22	256 bytes else
270		CMFA	#\$FE	calculate how
280		BCS	PUN23	many bytes
290	PUN22	LDAA	#\$FE	left to write
300	PUN23	STAA	\$A011	save frame count this record
310		STAA	\$A00E	save byte count this record
320		LDX	#\$MTAPE	write CR/FL,null,null,X1, record header
330		JSR	\$E07E	PDATA1
340		CLRB		zero checksum
350		LDX	#\$A011	write frame count
360		BSR	PUNT2	
370		LDX	#\$A00F	write start address for this record
380		BSR	PUNT2	
390		BSR	PUNT2	
400		LDX	\$A00F	
410	PUN32	BSR	PUNT2	load start location this record
420		DEC	\$A00E	write byte to tape
430		BNE	PUN32	decrement byte count this record
440		STX	\$A00F	if not done goto PUN32
450		COMB		save address for next record
460		TBA		set checksum
470		JSR	\$E1D1	move checksum to A reg
480		CPX	\$A004	OUTEE write checksum to tape
490		BNE	PUN11	check for end location
500		BRA	START	if not done goto PUN11
510	*			all done
520	PUNT2	ADDB	X	add byte to checksum
530		LDAA	X	load A reg with byte to output
540		JSR	\$E1D1	OUTEE output to tape
550		INX		increment for next byte
560		RTS		return
570	CLR	FDB	\$1316	home up, erase to end of frame
580		FCC	/INPUT BEGIN,END ADDRESS FOR SAVE/	
590		FCB	\$D,\$A,\$40,4	home, EOF,"@"
600	MTAPE	FCB	\$D,\$A,...,X,1,4	CR,LF,null,null,X,1 header record
610	DIR	FDB	\$1316	home,EOF
620		FCC	/INPUT PROGRAM START ADDRESS/	
630		FCB	\$D,\$A,\$40,4	CR,LF,"@"
640		END		

Program 1. PUNCH binary program.

How to Use the Binary Dump/Load Programs

This program was written for the SWTPC 6800 computer using the SWTPC TVTII and the SWTPC AC-30 cassette interface. For any other configuration, modification to the procedures may be required; however, the basic program should remain the same.

I have found it best to have both routines saved, along with their starting

address, in MIKBUG format on the same tape, with the load routine first. This way I first load the program to be saved into memory. Then read in the LOAD program with MIKBUG. I then put a blank tape in the cassette recorder and save this LOAD routine, along with its starting address, out to tape with MIKBUG. I then switch the cassette interface to the local mode and enter S9 G, then stop the recorder. Now I load in the PUNCH program

with MIKBUG and enter G. I then get the command INPUT PROGRAM START ADDRESS and @ on the TVTII. At this point it is important to move the status switches on the AC-30 cassette interface to off for the read and on for the record functions. This is necessary because the PUNCH program will be outputting bytes which would be decoded by the interface to start and stop the reader and recorder. Once the recorder

has started I enter the start address of the program. Next the command INPUT BEGIN, END ADDRESS FOR SAVE will be printed. I simply enter the begin and end address of the block of memory to be saved. The program will then start to output characters which will make you think something is wrong. This output is normal since it is outputting eight-bit binary words for which there is no ASCII equivalent.

When the save is complete the command INPUT BEGIN, END ADDRESS FOR SAVE will again be displayed. If there is another block to be saved, just enter the begin and end address for this new block. If nothing more is to be saved, switch the AC-30 interface to the local mode and enter X9. This is the end of file record. The save is now complete.

To load the saved program back into memory enter an L for the MIKBUG load routine, load the tape into the reader and place the read status switch on the cassette interface to the on position. The LOAD program will load and execute from the G entered on the saved tape. At the completion of the load the system will be in the MIKBUG monitor and by entering a G will execute your program.

If a string of question marks appears on the screen during the load, this indicates a checksum error. To recover from this, either start the load all over again or back the tape up a few inches, load the start address of the LOAD program into locations A048-A049 and enter G. Then start the tape again. If this last procedure is used, it will be necessary to reenter the start address of your program in location A048-A049 before you enter G to start your program.

Now there is no reason to shy away from those larger programs you have always wanted. So start loading the binary way and save lots of valuable time. ■

1000		NAM	LOAD BINARY	
1010		OPT	O.S	
1020		ORG	\$1E00	
1030	BEGIN	LDS	#\$A047	move stack
1040	START	BSR	INPUT	read byte from tape
1050		CMPA	#'X	check for record mark
1060		BNE	START	no goto START
1061		BSR	INPUT	read next byte
1070		CMPA	#'1	check for data record
1080		BEQ	BL1	yes, goto BL1
1090		CMPA	#'9	check for end of file record
1100		BNE	START	no, goto START
1110		JMP	\$E0E3	CONTRL all done return to monitor
1120	BL1	CLR	CHECK	clear checksum
1130		BSR	INPUT	read byte count from tape
1140		TAB		move it to B reg
1150		BSR	INPUT	read first half of start address
1160		STAA	ADDR	
1170		BSR	INPUT	read second half of start address
1180		STAA	ADDR+1	
1190		LDX	ADDR	load index reg with start address
1200	BL2	BSR	INPUT	read data byte from tape
1210		STAA	X	store data byte
1220		CMPA	X	check to be sure it was restored ok
1230		BNE	BL3	no good goto BL3
1240		INX		increment index reg
1250		DECB		decrement byte count
1260		BNE	BL2	if not zero goto BL2
1270		BSR	INPUT	read checksum from tape
1280		INC	CHECK	increment checksum
1290		BEQ	START	if checksum good goto START
1300	BL3	JMP	\$E040	LOAD19 error encountered stop processing
1310	*		subroutine to read data from tape	
1320	INPUT	BSR	INE	get one byte from tape
1330		PSHA		save A reg
1340		ADDA	CHECK	add checksum to A reg
1350		STAA	CHECK	store new checksum
1360		PULA		restore A reg
1370		RTS		
1380	*		SUBROUTINE TO REPLACE MIKBUG INEE	
1390	INE	PSHB		
1400		JSR	\$E1A5	
1410	IN1	LDAA	X	
1420		BMI	IN1	
1430		CLR	2,X	
1440		JSR	\$E1F3	
1450		JSR	\$E1EF	DEL
1460		LDAB	#4	
1470		STAB	2,X	
1480		ASLB		
1490	IN2	JSR	\$E1EF	DEL
1500		SEC		
1510		ROL	X	
1520		RORA		
1530		DECB		
1540		BNE	IN2	
1550		JSR	\$E1EF	DEL
1560		JMP	\$E1E3	IOUT2
1570	CHECK	RMB	1	checksum
1580	ADDR	RMB	2	address
1590		END		

Program 2. LOAD binary program.

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Total system design. The Heathkit computer line, both hardware and software, has been designed from the ground up to be a total computing system that meets all the needs of the computer hobbyist. The two mainframes are based on performance-proven well-documented MP modules, the 8080A and LSI-11. Using these CPU's was a conscious design decision, because of their proven performance, reliability and efficiency, and the tremendous amount of existing applications programs, documentation and source materials that are available. The Heath-designed CRT terminal, paper tape reader/punch, serial and parallel interfaces make total system setup easy and fast, and the Heath-designed software provided assures immediate usefulness and versatility.

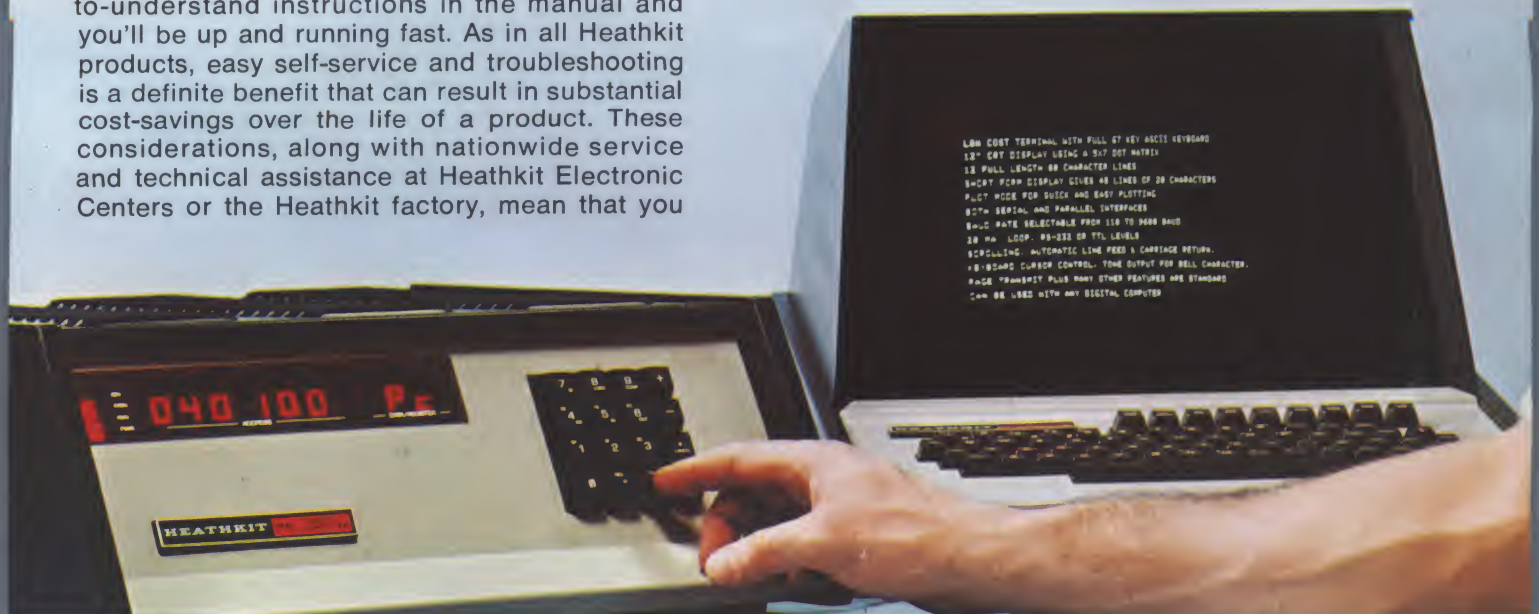
Superior documentation. Heath Company is world-famous for the accuracy and clarity of its instruction manuals. The Heath computer line continues this well-deserved reputation. Assembly and operations manuals are written with easy-to-understand step-by-step instructions that leave nothing to chance. Simply follow the easy-to-understand instructions in the manual and you'll be up and running fast. As in all Heathkit products, easy self-service and troubleshooting is a definite benefit that can result in substantial cost-savings over the life of a product. These considerations, along with nationwide service and technical assistance at Heathkit Electronic Centers or the Heathkit factory, mean that you

have the most reliable protection for your computer investment available anywhere.

System versatility. Both Heathkit computers offer full expansion potential to provide outstanding flexibility and adaptability to meet any application. Mass storage capability is available in both audio cassette and paper tape format on the H8 and in paper tape format on the H11 for added convenience. Additional memory expansion boards can be added to either unit, along with an expanding number of I/O devices.

Continuing Development. Heath will continue to design and develop new compatible products for their computer systems. Coming in the future will be — floppy disk storage, line printer, additional applications programs, and self-instructional courses in programming and assembly languages. All Heathkit computer users are eligible to join HUG (the Heath User's Group) and H11 customers are eligible to join DECUS, the Digital Equipment Computer User's Society.

We're confident you'll find the Heathkit computer line one of the most intelligent, sensibly developed and complete product lines available today. It offers you total versatility and expansion capability to go wherever your imagination and computing prowess take you. And, in the Heathkit tradition, it offers the best price/performance and reliability combination you'll find anywhere.



THE HEATHKIT H8 COMPUTER



A unique, value-packed computer featuring an "intelligent" front panel with built-in extended ROM monitor, octal entry keypad and digital readout, exclusive Heath bus, a pre-wired and tested 8080A-based CPU, and complete systems software at no extra cost!

\$375⁰⁰



HEATHKIT 8-BIT DIGITAL COMPUTER

A low-cost digital computer that's easier to build and to use! Features an intelligent front panel with keyboard entry and 9-digit display, a heavy-duty power supply with enough extra capacity for memory and I/O expansion and

a 50-line fully buffered bus capable of addressing 65K bytes and a mother board with positions for up to 10 plug-in circuit boards. Includes BASIC, assembler, editor and debug software at no extra cost!

The **Heathkit H8 computer** is an 8-bit machine based on the popular 8080A chip. It is one of the lowest-cost general-purpose computers on the market, and thanks to Heath's exclusive design, one of the most versatile.

The **interrupt controlled "intelligent" front panel** gives you far more power and control than is found on conventional units with bit switches and indicators. The 16-digit keyboard allows octal data entry and control that's far faster and less error prone than binary switches. The 9-digit octal readout provides you with more information than conventional models too.

The **octal keyboard and display** emulate a true hardware front panel with complete access to memory, all registers and functions. The 9-digit seven-segment octal display has three readout modes: 6 digits of address and 3 digits data; 6 digits register data and 2 digits register identification; and three digits data with three digits port address. The front panel functions are defined by a panel monitor control program (PAM-8) stored in a 1K x 8 ROM on the CPU board. The complete access to 8080 internal circuits and functions makes the H8 an ideal trainer and learning tool.

Complete front panel functions include: display and alter of memory locations; display and alter of registers; dynamic monitoring of registers or memory during program execution; program execution control including break-point capability and single instruction step; automatic tape load and store through a built-in routine that allows programs to be loaded with a single button; and write or read any I/O port. The front panel of the H8 is so versatile it's like having a mini I/O terminal built right in!

Other features of the H8 front panel include status lights for power-on, run, monitor and interrupt enable; a built-in speaker for audible feedback on keyboard entry. The speaker also can be programmed for variable tones, permitting a variety of special effects to be generated.

The **CPU board** is fully wired and tested. It features the 8080A, clock, systems controller, ROM monitor and full bus buffering. Seven vectored interrupts are available on the bus for quick response to your I/O requests. A built-in clock lets you design and run in real time.

The **H8 uses an exclusive, Heath-designed bus** which incorporates many practical improvements over existing busses. The bus is fully buffered to reduce noise and crosstalk and is "glitch" free to eliminate timing problems. Three-state line drivers and receivers are used on all bus lines to eliminate loading problems. The 50 lines include address, data, control, clock and interrupt lines, plus all signals needed to support the 8080 MPU and virtually any I/O or memory accessory. The bus is implemented on a heavy-duty printed circuit mother board with wide, heavy copper foils for greater physical strength plus reduced crosstalk and noise. The board has 10 positions for installing

connectors that accept the front panel, CPU, memory, I/O and accessory cards. All I/O bus connectors are included with the mother board for fast and easy expansion when you want it.

The **H8's built-in power supply** is convection cooled for adequate ventilation without the use of noisy fans. Separate IC regulators provide distributed regulation with a heat sink on each circuit board for excellent heat dissipation. Power supplies of +8, -18 and +18 volts are provided to handle up to 32k memory plus three I/O interfaces. Switch-selectable 120 V, 60 Hz or 240 V, 50 Hz AC increases versatility.

The **H8 includes all system software** in 1200 baud audio cassette form at no extra charge. The Benton Harbor BASIC™ is an enhanced version of standard Dartmouth BASIC with unique statements and commands to extend usefulness. The efficient compression techniques of the Benton Harbor BASIC permit you to put more program in less space.



All H8 systems software is supplied in audio cassette form. Also available in paper tape (H8-15, page 5) at extra cost.

HASL-8 The Heathkit Assembly language is a 2-pass absolute assembler that lets you program with easily understood mnemonics and generates efficient machine language code. A minimum of 8K memory is required.

The **TED-8** software is a line-oriented text editor used for generating source programs for the assembler or general word processing. Requires a minimum of 8K memory.

The **BUG-8** a powerful terminal console debug program, is an enhanced and extended version of the front panel monitor program to allow entry and debugging of user machine language programs via an external terminal. Requires 3K memory plus user program.

The H8 is housed in a rugged, heavy-duty cabinet, 16¼" W x 6½" H x 17" D. Requires at least one H8-1 Memory.

Kit H8, Shpg. wt. 30 lbs. 375.00

Suggested applications for the H8 computer: As a trainer—learn microprocessor operation, interfacing and programming. The powerful front panel lets you get at and use all parts of the unit.

As an entertainment center—use game and other applications programs for entertainment the whole family can enjoy.

As a hobby computer—the H8 can be used to process any information you program into it—it's perfect for hobby experimentation and design. A variety of peripherals and interfaces let you use it with other equipment—run your Ham radio station, control your model railroad systems, etc.

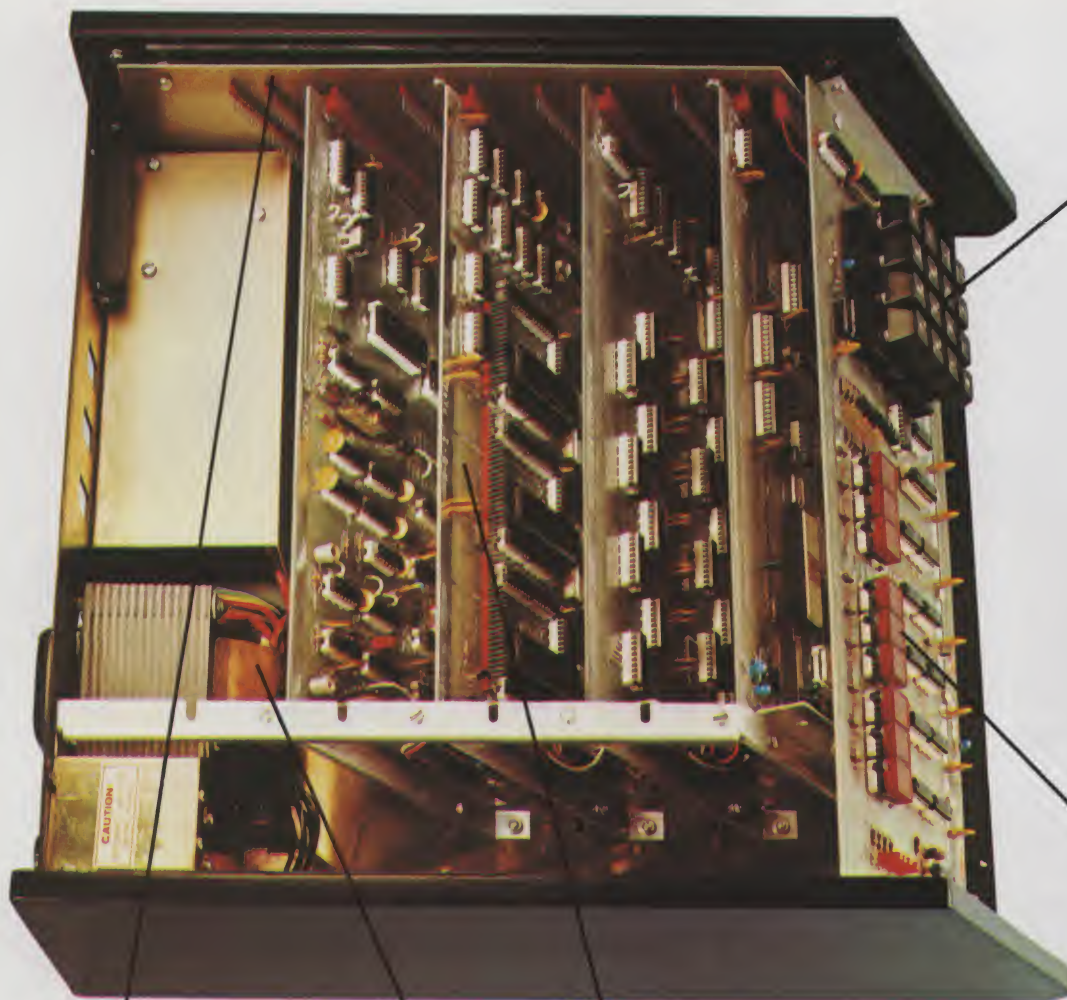
As an educational system—the H8 is ideal for schools, community colleges, libraries, etc. Full H8 software permits teaching BASIC plus machine and assembly language programming.

As a home management center—use the H8 to keep telephone numbers, monitor your budget, keep your checkbook balanced, do your income taxes, inventory your personal belongings. There are hundreds of ways the H8 can make your life more convenient.



Comprehensive Heathkit assembly and operations manuals give you the superior documentation you NEED for a thorough understanding of your H8.

Systems software is supplied in audio cassette format.



Its unique front panel keyboard makes the H8 the most powerful and sophisticated low-cost general-purpose computer available. Just take a look at these features!

- Direct-access to registers and memory even while program is running
- One button load and dump for fast, uncomplicated system startup
- Single instruction key lets you "step" through programs for easy debugging, program evaluation and learning
- Input/output keys let you communicate directly with any port

The unique Heath-designed 50-pin bus is implemented on a heavy-duty printed circuit board with heavy copper-foil bus lines. The 10-position mother board is complete with all connectors. The bus lines are fully buffered to eliminate noise and crosstalk, and "glitch-free" to prevent timing problems.

Modular circuit boards slide into the H8 mainframe for easy memory and I/O expansion, easy access for servicing. The boards are in a semi-vertical position with unconfined heat sinks to enhance convection cooling and improve heat dissipation.

Heavy-duty power supply, rugged steel chassis and securely mounted and braced circuit boards make the H8 a truly reliable and long-life machine.

Unique Heathkit Software.

The Heathkit software supplied with the H8 computer has a number of features that make it easier to use and more practical than conventional systems. Automatic "command completion" simplifies typing; dynamic syntax checking instantly alerts you to errors and a special user configuration lets you really personalize your system. H8 software pushes the state-of-the-art a generation ahead — it's memory efficient to give you more computing power for your memory dollar, modular design for easy expansion, and thoroughly documented for easy programming and maximum effectiveness.

Memory Display



High Order Address Location Low Order Address Location Data at Location 040 100

Register Display



High Order Contents Low Order Contents Register Identification

I/O Port Display



Data Port Number

H8 "Intelligent" Front Panel

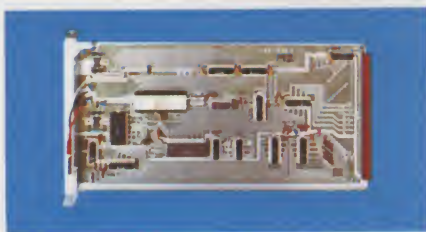
The H8 front panel digital readout is the most informative display available on any personal computer to date. All displays are continuously updated even while your program is executing, giving you instant access to registers and memory for direct monitoring of program activity.

MEMORY DISPLAY — Shows memory location and contents using 6 digits for address and 3 digits for data.

REGISTER DISPLAY — Shows CPU-register contents using 6 digits for data and 2 digits for register identification.

I/O PORT DISPLAY — Shows I/O port data and location using 3 digits for data and 3 digits for port address.

H8 ACCESSORIES, SOFTWARE AND MANUAL SET



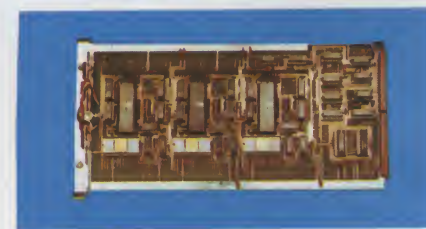
The H8 CPU is fully wired and tested to insure quick and trouble-free system startup. It contains the performance proven 8080A microprocessor chip, a 1Kx8 ROM with monitor program for controlling the front panel and input-output (load-dump) routines. Other features of the CPU include: 7 vectored interrupts, DMA capability, crystal-controlled clock and fully buffered bus with three state drivers. Use of the 8080A, which has the largest software library of any microprocessor, along with Heath software and documentation, makes the H8 one of the most practical and immediately useful computers you can own.



H8-1 Memory Board. 8Kx8 memory card supplied with 4K memory, plugs directly into H8 bus. Features maximum storage capacity of 8192 8-bit words. Uses modern 4Kx1 static memory IC chips for easy assembly and service. Access time, less than 450 nS. With on-board regulators, heat sinks and full buffering. Expandable to 8K memory with H8-3 chip set below.
Kit H8-1, Shpg. wt. 2 lbs. **140.00**

H8-3 Chip Set. Kit of eight 4K static memory IC's. Expands H8-1 to full 8K storage. With sockets.

Kit H8-3, Shpg. wt. 1 lb. **95.00**



H8-2 Parallel Interface. Connects H8 to any parallel device such as a paper tape reader/punch (required for H10) or line printer. Has three independent parallel ports, each with 8 bits input and 8 bits output and universal handshaking capability. Compatible with all Heath software. 390 μ S maximum transfer time. With diode-clamped inputs, buffered outputs and full interrupt capability.

Kit H8-2, Shpg. wt. 3 lbs. **150.00**



H8-5 Serial I/O and Cassette Interface. Connects the H8 to serial devices such as the H9 video terminal (page 10) or the H36 DEC Writer II (page 12). Features jumper selectable data rate from 110 to 9600 baud, plus common input/output interfaces including 20 mA current loop and EIA RS-232C compatible levels. The cassette recorder interface permits the use of standard cassette recorders (Heathkit ECP-3801, page 12). Uses the popular Byte/Manchester or "Kansas City" standard recording format with a 300 or 1200 baud read/record rate. Control lines for remote start and stop of two cassette units allow separate record and playback for easy program or file editing. Also has full interrupt capability. LED test circuit for easy board setup and overall system servicing. Fully compatible with all Heath software.

Kit H8-5, Shpg. wt. 3 lbs. **110.00**

NOTE: Proper operation of the H8-5 is assured only if you use the Heath ECP-3801 cassette player/recorder and Heath-recommended recording tape (ECP-3802, page 12). Heath is not responsible for improper operation associated with other cassette units.

Extended Benton Harbor BASIC

Extended Benton Harbor BASIC is an enhanced and more powerful version of the BASIC supplied with the H8. It provides even faster operation and includes character strings, additional convenience commands and math functions, dynamic storage allocation, access to real time clock, keyboard interrupt processing, expanded error messages and recovery ability, LED display control and key pad support. A minimum of 12K memory is required to run this BASIC, 16K is preferred if full use is to be made of its capabilities.

H8-13 (1200 baud audio cassette)
Shpg. wt. 1 lb. **10.00**

H8-14 (fan fold paper tape)
Shpg. wt. 1 lb. **10.00**

Paper Tape Systems Software

A paper tape version of the systems software supplied with the H8 computer. It consists of four fan fold paper tapes, one each for Benton Harbor BASIC, HASL-8 assembler, TED-8 editor, and BUG-8 debug. For use with the H10 paper tape reader/punch or other paper tape I/O equipment.

H8-15, Shpg. wt. 1 lb. **20.00**

H8 Manual Set

Find out about the H8 before you buy! This manual set includes the complete assembly and operations manuals for the H8 Digital Computer, H8-1 memory card, H8-2 parallel interface, H8-3 4K memory expansion chip set, H8-5 serial and I/O cassette interface, H9 video terminal and H10 paper tape reader/punch. H8 software documentation covering monitor, editor, assembler, debug and BASIC is also included. In handsome 3-ring binder.

HM-800 Manual Set.

Shpg. wt. 11 lbs. **25.00**

The purchase price of the HM-800 manual set will be refunded when you buy the H8. Simply include HM-800 saleslip with your order.



You can get even more excitement and practical use from your H8 by joining HUG, the Heathkit User's Group. It will put you in contact with other Heathkit computer users, provide a program library and an informative newsletter to keep you up to date. A HUG application is enclosed with each Heathkit computer product. See page 12 for further details.

THE HEATHKIT H11 DIGITAL COMPUTER

Two of the finest names in modern electronics, Heath and Digital Equipment Corporation (DEC) combine to bring you the world's first 16-bit computer priced within reach of the general public!

\$1295⁰⁰



The H11 and all its accessories
will be available November 10th, 1977.

HEATHKIT®/DIGITAL EQUIPMENT CORPORATION®

H11 DIGITAL COMPUTER

Heath and DEC join forces to bring you mini-computer performance at a microcomputer price! The H11 features a fully wired and tested DEC KD11F board that contains the 16-bit LSI-11 CPU, 4096 x 16 read/write MOS semi-

conductor memory, DMA operation; and includes the powerful PDP-11/40 instruction set, PLUS Heath/DEC PDP-11 software. Equivalent commercial versions of the H11 would cost \$1,000's of dollars more!

The new Heath/DEC H11 personal computer is one of the most powerful and sophisticated units available today! It combines the advanced, performance-proven hardware and software of the LSI-11 with Heath's expertise in kit design and documentation to bring you a personal computer of almost incredible power and flexibility. Equivalent commercial versions of the H11 would cost over twice as much, and you still wouldn't get the superior documentation and support of the H11!

The LSI-11 bus is a mechanically and electrically superior bus with 38 high-speed lines containing data, address, control and synchronization lines. Sixteen lines are used for time multiplexing of data and addresses. All data and control lines are bidirectional, asynchronous, open-collector lines capable of providing a maximum parallel data transfer rate of 833K words per second under direct memory access operation.

The 16-bit CPU functions are contained on four MOS LSI integrated circuit chips. These chips provide all instructions, decoding, bus control, and ALU functions of the processor. The CPU has eight general registers which serve as accumulators, index, autoincrement/autodecrement registers or stack pointer.

The KD11F memory is a 4096-by-16 MOS semiconductor memory composed of LSI 4K dynamic RAM chips. These chips require little power, provide fast access time, and are refreshed automatically by the processor's microcode. Additional memory cards can be added to expand memory capacity up to 20K in the H11 cabinet (32K words total).

The backplane/card guide assembly holds the microcomputer and up to six I/O and memory modules. All LSI-11 bus data, control, and power connections are routed on the printed circuit backplane to each module location. The backplane/card guides are fully compatible with all standard DEC LSI-11 accessories.

An efficient, well-designed switching power supply provides the required DC voltage for the LSI-11 as well as all accessory modules. The supply features overvoltage and overcurrent/short-circuit protection, power fail/automatic restart and a built-in fan for quiet cooling. The dual primary power configuration can be connected for 115 V, 60 Hz or 230 V, 50 Hz input power.

Has single-level, vectored, automatic priority interrupt, real-time clock input signal line, ODT/ASCII console routine/bootstrap resident in microcode for automatic entry into debugging mode, replacement of panel lights and switches with any terminal device generating standard ASCII code, and the ability to automatically commence operation through resident bootstrap routines.

The H11 is supplied with versatile PDP-11 software including editor, relocatable assembler, linker, absolute loader, debug program, I/O executive program, dump routines, BASIC and FOCAL (See details below). The software requires a minimum of 8K memory, with 12K to 16K total memory recommended for maximum capability. Rugged metal cabinet measures 6½" H x 19" W x 17" D. For 110/220 VAC, 50/60 Hz.

Kit H11, Shpg. wt. 34 lbs. \$1295.00
NOTE: See DEC software license form on page 15.

POWERFUL HEATH/DEC PDP-11 SOFTWARE AT NO EXTRA COST!

The H11 includes a sophisticated software system that lets you get your computer up and running with practical programming capabilities. This paper tape based software would cost over \$1200 if purchased separately. A minimum of 8K memory is required to run the software. The programs include:

ED-11. Assists you in the creation and modification of ASCII source tapes, also used to write assembly language programs and for general text editing or word processing functions.

PAL-11S. Relocatable assembler converts ASCII source tapes into relocatable binary modules. This lets you create programs in small, modular segments for easier coding and debugging. These binary modules serve as inputs to LINK-11S.

LINK-11S. Link editor which links the modules created by the PAL-11S into a load module ready for execution on the H-11. The module is loaded into the H-11 via the Absolute Loader.



The H11 is complete with superior Heathkit documentation and versatile system software.

Absolute Loader. Loads absolute binary tapes into the H11 memory for execution.

ODT-11X. Lets you debug the programs which you have created. Permits modifying and controlling program execution "on the fly" for quick, efficient debugging.

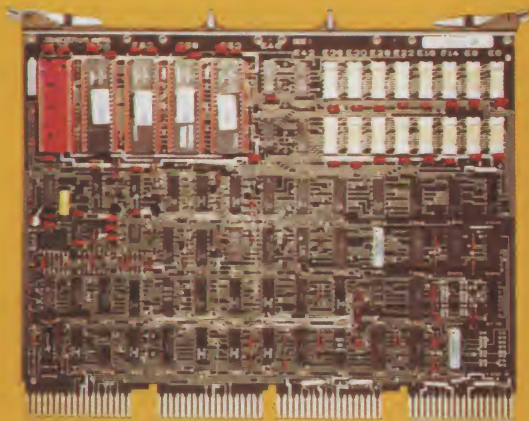
IOX. I/O executive program permits I/O programming without developing device-driving programs. Links to your programs using the LINK-11S. For use with high speed paper tape reader/punch and line printer.

DUMP-AB and DUMP-R. Lets you dump absolute binary contents of memory into the paper tape punch.

BASIC. DEC's powerful version of standard Dartmouth BASIC interpreter uses english-type statements and mathematical symbols to perform operations. Immediately translates, stores and executes the program. Includes string capability.

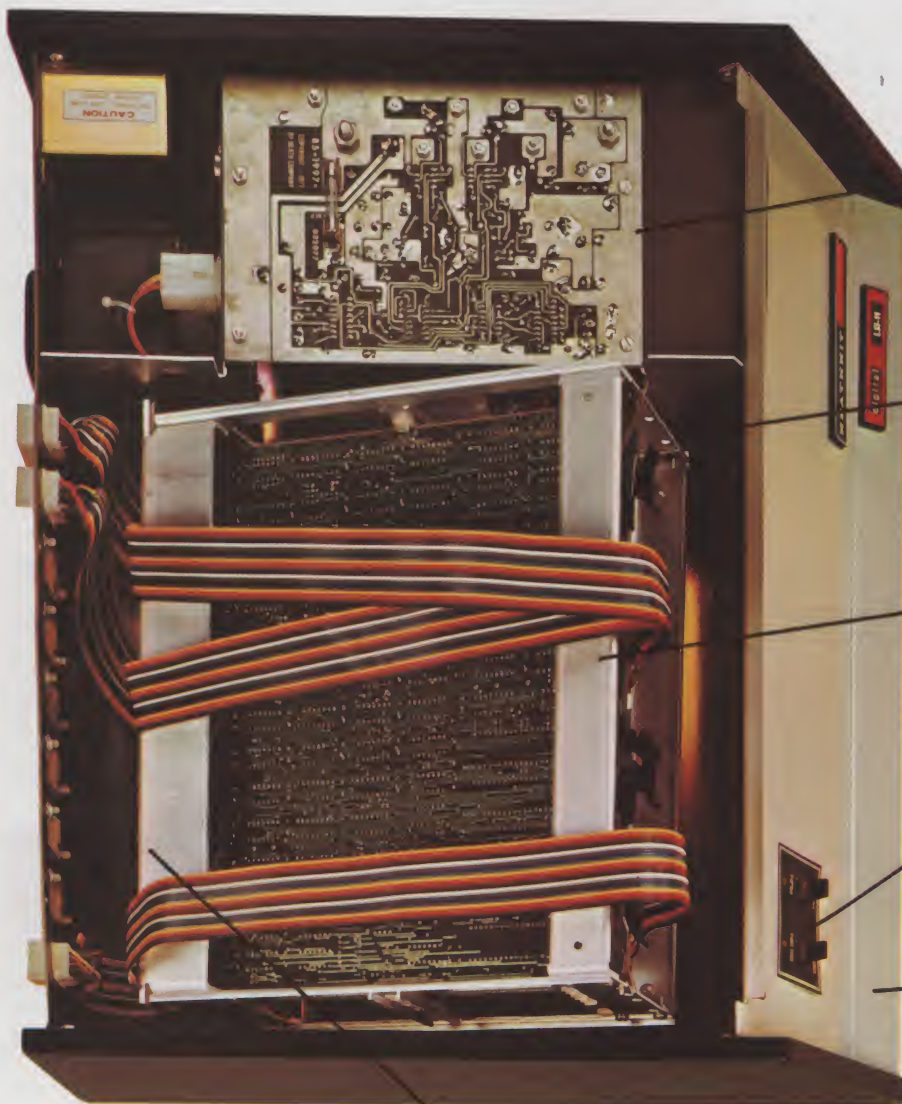
FOCAL™. DEC's own interpretive computer language which combines simplicity with computing power. Ideal for most scientific, engineering and math applications. FOCAL™ programs can be written and executed easily. Both 4K and 8K versions are included.

NOTE: H11 owners are eligible for membership in the Digital Equipment Computer User's Society (DECUS). This organization provides useful symposia, newsletters, program library and other useful information to help you get the most from your LSI-11 computer.



FULLY WIRED AND TESTED KD IIF BOARD

The "heart" of the H11 computer is the standard DEC LSI-11 microcomputer board. The 16-bit CPU functions are contained in four silicon gate N-channel MOS LSI integrated circuit chips for high reliability and superior performance. The 4096-by-16 read/write MOS semiconductor memory is composed of LSI 4K dynamic RAM chips that provide fast access time and require little operating power. The CPU executes the powerful PDP-11/40 instruction set with over 400 instructions. There are no separate memory I/O or accumulator instructions, so you can manipulate data in peripheral device registers as easily and flexibly as in memory registers. The LSI-11 board is supplied fully wired and tested to facilitate kit assembly and provide greater reliability and less chance of error.



Compact, efficient switching power supply uses less power to operate and generates less heat than conventional supplies. Overvoltage and overcurrent/short circuit protection, along with automatic power-up and power-down sequencing, provide high reliability and long life operation.

Built-in quiet-running fan provides efficient cooling and prevents heat buildup.

Card cage with backplane accommodates up to six accessory cards in addition to LSI-11. The card cage swings up for easy access and service even while the H11 is operating. Accessory boards slide directly into card guides with all connectors supplied.

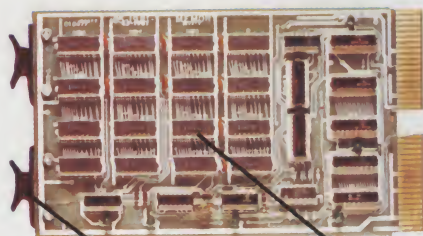
Front panel controls include DC power switch and run/halt switch. Status lights indicate processor activity.

Styled and sized to match Heathkit peripherals for total system continuity.

Rugged steel chassis and extra-thick backplane with heavy, solid connectors for added strength and years of superior performance.

The H11 and all its accessories will be available November 10th, 1977.

H11 ACCESSORIES, SOFTWARE AND MANUAL SET



Card handles provide easy removal and insertion in card cage

Sixteen state-of-the-art 4K static memory chips for high density storage

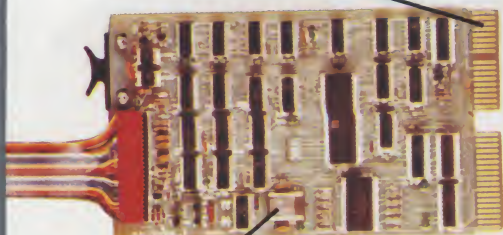
All IC's are socketed for easy kit assembly, easy access for service or troubleshooting



All inputs are diode-clamped for worry-free interfacing and system protection

Separate cables and rear panel connectors for high-byte and low-byte increase system flexibility

Gold-plated edge connectors maintain superior electrical contact for high reliability and long life



Quartz crystal and integrated baud rate generator has superior accuracy for reliable system interfacing

1 H11-1 4K Memory Expansion Module

Plugs into H11 backplane, adds 4K x 16-bit word capacity to H11 memory. Uses high-reliability 1Kx4 static MOS RAM chips. Access time is less than 500 nS. Has decode circuitry for operation on 4K address boundaries. Handle for easy removal and insertion. Compatible with PDP 11/03 and other LSI-11 backplane machines.

Kit H11-1, Shpg. wt. 2 lbs. 275.00

2 H11-2 Parallel Interface

General-purpose parallel interface featuring 16 diode-clamped latched data input lines, 16 latched output lines, 16-bit word or 8-bit byte data transfers. Has LSI-11 bus interface and control logic for interrupt processing and vectored addressing; control status registers compatible with PDP-11 software routines. Four control lines for output data ready, output data accepted, input data ready and input data accepted logic operations. Maximum data transfer rate, 90K words per second under program control. Maximum drive capability, 25-ft. cable. Plugs into H11 backplane, can be used with DEC PDP-11/03 and other LSI-11 backplane machines. Also compatible with TTL or DTL logic devices. The H11-2 is required for interfacing the H11 to the H10 Paper Tape Reader/Punch.

Kit H11-2, Shpg. wt. 2 lbs. 95.00

3 H11-5 Serial Interface

Universal asynchronous receiver/transmitter serial interface module for use between LSI-11 bus and serial devices such as the Heathkit H9 video terminal (page 10) or LA36 teleprinter (page 12). Has optically isolated 20 mA current loop and EIA interfaces; selectable baud rates of 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800 and 9600. Plugs into H11 backplane, fully compatible with PDP 11/03 and other LSI-11 backplane machines. With all mating connectors.

Kit H11-5, Shpg. wt. 2 lbs. 95.00

H11-6 Extended Arithmetic Chip

Adds powerful arithmetic instructions to the LSI-11, including fixed point multiply, divide and extended shifts plus full floating point add, subtract, multiply and divide. Helps minimize or eliminate arithmetic sub-routines, speeds up program execution and eases program development. Saves memory space too. 40-pin dual-inline package IC plugs into socket on KD11F board.

H11-6, Shpg. wt. 1 lb. 159.00

Manual Set for H11 Computer

Includes complete assembly and operation manuals for the H11 Digital Computer, H11-1 4K memory board, H11-2 parallel interface, H11-5 serial interface, H9 CRT terminal, and H10 paper tape reader/punch. Also includes complete software documentation — monitor, editor, assembler, linker, BASIC, FOCAL and related software. In handsome 3-ring binder.



ware documentation — monitor, editor, assembler, linker, BASIC, FOCAL and related software. In handsome 3-ring binder.

HM-1100 Manual Set,
Shpg. wt. 12 lbs. 25.00

NOTE: The price of the manual set can be deducted when you order an H11.

NOTE: DEC, DIGITAL, FOCAL and PDP are registered trademarks of Digital Equipment Corporation.

Special DEC Software License Requirement

H11 purchasers are required to fill out and sign the DEC license agreement on page 15. Please do so and include with your H11 order. Heath cannot ship merchandise without this license agreement.

THE HEATHKIT H9 VIDEO TERMINAL

One of the lowest-cost full ASCII terminals available anywhere — features a bright 12" CRT display with twelve 80-character lines, 67-key keyboard, all standard serial interfaces, plus a fully wired and tested control board and a wiring harness for simplified assembly.

\$530⁰⁰



LOW COST TERMINAL, WITH FULL 67 KEY ASCII KEYBOARD
12" CRT DISPLAY USING A 5X7 DOT MATRIX
12 FULL LENGTH 80 CHARACTER LINES
SHORT FORM DISPLAY GIVES 48 LINES OF 20 CHARACTERS
PLOT MODE FOR QUICK AND EASY PLOTTING
BOTH SERIAL & PARALLEL INTERFACES
BAUD RATE SELECTABLE FROM 110 TO 9600 BAUD
20 MA LOOP, RS-232C AND TTL LEVELS
SCROLLING, AUTOMATIC LINE FEED & CARRIAGE RETURN
KEYBOARD CURSOR CONTROL, TONE OUTPUT FOR BELL CHARACTER
PAGE TRANSMIT PLUS MANY OTHER FEATURES STANDARD
CAN BE USED WITH ANY DIGITAL COMPUTER

H9 LONG AND SHORT-FORM VIDEO DISPLAY TERMINAL

The H9 video terminal is a general-purpose computer peripheral designed for use with the Heathkit H8 or H11 computers. It provides keyboard input and a CRT for the convenient entry and display of computer programs and data. The H9 can be used with any digital computer in dedicated stand-alone applications or in time-sharing systems.

Character format is standard upper case 5 x 7 dot matrix. The long form display is twelve 80-character lines. The short form display is forty-eight 20-character lines in four 12-line columns. The automatic line carryover feature executes line feed and return when line exceeds character count on both long and short form displays. A built-in oscillator/speaker generates a 4800 Hz tone and serves as audible end-of-line warning.

Auto-scrolling is featured in both long and short form. In the long form, as the line enters at bottom, the top line scrolls off-screen; in the short form, as new column enters from right, the left column scrolls off-screen. Auto-scrolling can be



Long form — twelve 80-character lines



Short form — forty-eight 20-character lines



Plot mode — graphs, curves, simple figures

Three separate modes give the H9 real display versatility

defeated with a front panel switch. The cursor mark indicates the next character to be typed for accurate positioning. Cursor control keys include up, down, left, right and home. Serial data baud rates are selectable from 110-9600. Baud rate clock output and reader control are available on the rear panel connector. The erase mode permits automatic full page erase or erase to end of line starting at cursor position. A transmit page function allows a full page to be formatted, edited and modified, then transmitted as a block of continuous data.

The plot mode permits graphs, curves and simple figures to be displayed. Plot-



Control PC board is fully assembled and tested for added reliability and simplified kit assembly. A wiring harness with connectors helps reduce time-consuming point-to-point wiring.

ting can be accomplished via the keyboard or from external inputs.

The H9 serial interface provides EIA RS-232C levels, a 20 mA current loop or standard TTL levels. Parallel interfacing includes standard TTL levels, 8 bits input and 8 bits output and 4 handshaking lines.

Ultra-compact size, only 12½" H x 15½" W x 20¼" D, makes the H9 ideal for desktop or console applications. For 110 VAC, 60 Hz or 230 VAC, 50 Hz.

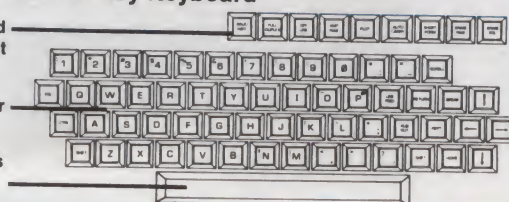
Kit H9, Shpg. wt. 50 lbs. 530.00

Full ASCII 67-key Keyboard

Function keys are positioned away from characters to prevent miskeying and error.

Standard typewriter keyboard for easy, more accurate input.

Wide, easy-to-use space bar aids accurate typing.



THE HEATHKIT H10 PAPER TAPE READER/ PUNCH

A general-purpose mass storage peripheral designed for use with the H8 and H11 computers plus any other computer. Features a heavy-duty built-in power supply, totally independent punch and reader and a copy mode for fast, easy tape duplication.

\$350⁰⁰



H10 DELUXE PAPER TAPE READER/PUNCH



Heavy-duty solenoids for reliable, long-life operation

Precision machined punch block for accurate, consistent punched holes

Advanced reader design with stepper motor and solid-state sensors for accurate reading

The H10 is a complete paper tape reader/punch mass storage peripheral using reliable low-cost paper tape. It's fully compatible and styled to match with the H8 and H11 computers. It also works reliably with any other computer through a parallel interface. The H10 uses standard 1" wide roll or fan-fold 8-level paper tape. Standard punched paper tape gives you the reliability, durability and trouble-free handling you need for effective mass storage of programs and data.

The reader reads tape at a maximum rate of 50 characters per second. A full sensitivity adjustment on each channel permits any color, thickness, quality (oiled

or unoled) paper tape to be used. Sensitive photo Darlington transistors and an incandescent lamp reader head provide reliable reading. The powerful stepper motor drive insures accurate tape positioning and movement.

The punch operates at a maximum speed of 10 characters per second. Precise ratchet/solenoid drive and reliable solenoid control of punches provide high-accuracy punching. The precision die-block punch head gives you positive and consistent punching.

Controls include power on-off, read and punch start. A feed control feeds blank paper tape through the punch to produce leader tape. A copy control on the rear panel permits tape being read to be duplicated by the punch for efficient and accurate tape copying.

Interface has parallel 8-bit input bus for punch, parallel 8-bit output bus for reader, standard TTL logic levels and handshaking lines for both reader and punch. A rear panel 24-pin interface connector and mating cable are supplied. The H10 is fully compatible with Heathkit H8 and H11 computers when the appropriate parallel interface accessories are used. It can also be interfaced with other computers with parallel interface facility.

Accessories include holder for roll paper tape, chad collector tray, and collector box for fan-fold tape. With 8" roll (900 ft.) blank paper tape.



Styled to match the Heathkit H8 and H11 computers. Cabinet with metal top and rugged steel chassis, 12 $\frac{1}{2}$ " H x 9 $\frac{3}{4}$ " W x 19 $\frac{1}{2}$ " D. For 110-130 VAC, 60 Hz, or 220-240 VAC, 50 Hz.

Kit H10, Shpg. wt. 29 lbs. **350.00**

H10-2, Three Blank Rolls Paper Tape, each 8" diameter, 900 ft. min.

H10-2, Shpg. wt. 5 lbs. **10.00**

H 10-3, Three Boxes Blank Fan-fold Tape. Approx. 1000 ft. each.

H10-3, Shpg. wt. 5 lbs. **10.00**



ECP-3801 Cassette Recorder Storage Device

Has volume and tone controls, pushbuttons for record, play, rewind, fast forward, stop and eject, built-in 3-digit counter with reset button. Factory wired, not a kit.

ECP-3801, Shpg. wt. 6 lbs. **55.00***

Heath recommended high output, low noise, premium grade audio recording tape. Pack of three 30-minute blank cassettes.

ECP-3802, Shpg. wt. 1 lb. **per pack 5.00**

*NOTE: Proper operation of the H8-5 and H8 software is assured only when the ECP-3801 cassette recorder and ECP-3802 tape is used. Heath does not assume responsibility for improper operation resulting from the use of any other cassette units.

HUG®—the Heathkit User's Group

Our new user's group brings you in contact with other Heathkit computer owners and users, provides a newsletter, a program library, new product information and hardware/software ideas. Membership in HUG is a useful, practical way to get the maximum enjoyment and benefit from your Heathkit computer system. Here's what you get:

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- An attractive 3-ring binder to hold newsletters, software documentation and other materials.
- Program submission forms • Software library catalog
- HUG membership list • Credit toward purchase of software

Dues are \$14.00 for one year. Complete details of HUG membership are included with every Heathkit computer product. H11 owners are also eligible for membership in DECUS, see page 7 for details.

Heathkit 12

LA36 DEC Writer II Keyboard Printer Terminal

The famous LA36 DEC Writer II with true 30-cps throughput, variable-width forms handling, 128-character upper/lower case set, and extra-quiet operation. Fully assembled, factory tested and ready to use!

The LA36 is an advanced technology teleprinter offering fast, reliable operation at one of the best price/performance ratios in the industry. It features a 7x7 dot matrix print head for crisp, clear character formation; switch-selectable 10, 15 and 30 cps printing speeds; variable width forms handling from 3 to 14 $\frac{1}{8}$ " wide; adjustable right and left hand tractors for precise margin positioning; half or full duplex operation; ANSI-standard multi-key rollover and a typewriter-like keyboard.

The precision-designed stepper motor paper feed has fine vertical adjustment for accurate forms placement. LA36 will handle up to 6-part forms with a .020" maximum pack thickness. Print format is 132-column, with 10 characters per inch horizontal spacing and 6 lines per inch vertical spacing. Uses the entire 128 character ASCII upper/lower case set with 95 printable characters. A CAPS-lock key simplifies data entry. A parity check on output prints a replacement character, strappable to odd, even, or none with mark or space. A last-character visibility feature moves the head four columns to the right when printing stops, returns to proper position when printing is resumed.

The integral 20 mA current loop interface makes the LA36 compatible with both the H8 and H11 computers, as well as all other hobby and personal computers. Operates on 90-132 VAC or 180-264 VAC for reliable performance even under brown-out conditions. With connecting cable and integral stand for easy setup. Overall size, 27 $\frac{1}{2}$ " W x 33 $\frac{1}{4}$ " H x 24" D.

H36 (LA36 DEC Writer II) Shipped Motor Freight, prepaid to your nearest terminal within the Continental U.S. Include your phone number on order for notification of arrival. Arrangements for home delivery at extra charge at your option. **NO C.O.D. ORDERS ACCEPTED.** **\$1495.00**

H36-1 Fan-fold paper for H36. Standard 14 $\frac{7}{8}$ " x 11" white and green, single part, lined paper. 3450 sheets per carton.

H36-1, Shpg. wt. 50 lbs. **30.00**

H36-2 EIA Interface. Provides EIA RS232-C or CCITT-V24 interface for LA36. Includes auto answer, timed disconnect and half/full duplex logic. Straps are available to send timed break (230 mS), 3000 mS long space, forced disconnect or do nothing (stops printing, discards data) on a paper-out condition. Modem controls and a 9-ft. cable with 25-pin data-set type connector are also supplied. Factory wired, not a kit.

H36-2, Shpg. wt. 1 lb. **65.00**

APPLICATIONS SOFTWARE—COMING SOON!

Both the H8 and H11 Digital Computers are supplied with complete systems software that provide you with everything you need to develop your own specific applications programs. However, you can make your computer immediately useful by using the programs below. These programs represent the beginning of a complete series of application software packages that will allow you to get immediate value from your computer system without a time consuming software development effort on your part. Described below are a series of game packages that make your computer an excellent source of entertainment and leisure time activities.

BLACKJACK. An interactive program game that allows four players to play the card game blackjack on the computer. The computer performs all of the functions of the dealer and keeps track of player progress, winnings and losses. The program is written in and runs under extended BASIC and requires a minimum of 16K of RAM in the H8 and 8K in the H11. Standard Las Vegas casino blackjack rules apply.

BIORHYTHM. This popular applications program computes standard biorhythm information and plots sinusoidal curves of your physical, emotional, and intellectual characteristics over a given time period. The biorhythm program will show you your ups and downs and will tell you your good and bad days. It will help you plan your activities. While this program is not a game, it is an entertaining activity that you and your friends and family will enjoy. The program runs under extended BASIC and requires 16K of RAM in the H8 and 12K RAM in the H11.

STARTREK. Startrek is perhaps the most popular computer game available. It allows you to guide, control and command the Starship Enterprise in its travels through the galaxy, fighting Klingons and solving a variety of problems. A truly challenging, sophisticated and entertaining computer game. Runs on the H8 or H11 computers with 8K of RAM or more.

GAME SET #1. This software package lets you play 8 popular computer games. These games include Craps, Orbit, Tic Tac Toe, Nim, Hexapawn, Hangman, Hmrabi, and Derby. 8K RAM or more is required on either the H8 or H11. These games will provide hours of entertainment for you and your family.

GAME SET #2. Another popular game package for the H8 and H11 computers. Contains 8 popular computer games including bagles, slot machine, gomoko, yachtze, apollo, gunner, wumpus, and cube.

AVAILABILITY. Blackjack, Biorhythm and Startrek will be available after October, 1977. Game Set #1 will be available November, 1977 and Game Set #2 available, February, 1978.

Order a complete Heathkit computer system and SAVE!



The ECP-3801 is the Heath-recommended cassette recorder/player for use with the H8 computer software. See opposite page for complete description.

SYSTEM ONE

The minimum recommended H8 system

H8 Computer	\$375
H8-1 4K Memory	140
H8-3 4K Chip Set	95
H8-5 Serial I/O and Cassette Interface	110
H9 Video Terminal	530
ECP-3801 Cassette Recorder/Player	55

If purchased separately, \$1305.00

Heath System price is **\$1239⁷⁵***

Choose any of the Heath-recommended systems shown here, the specially-priced HS-11 system below, or "roll your own" with a selection of products you choose. Any way you do it, you'll get a top-value, high-performance system, and you'll SAVE 5%!

Here's how to qualify for the 5% computer systems discount:

1. Select either the H8 or H11 and one major peripheral (H9, H10 or LA36).
2. Choose the I/O interface, memory and software accessories you need.
3. Specify each in the spaces provided on the order blank.
4. Deduct 5% from the total price of the products (excluding shipping and handling charges).

*Systems illustrated already have discount prices calculated for you.

From time to time, Heath will offer specially priced total systems such as the HS-11 below. These systems will be discounted even deeper than 5% to provide you with even MORE value for your computer dollar!

SYSTEM TWO

H8 Computer	\$375
Two H8-1 4K Memories	280
Two H8-3 4K Chip Sets	190
H8-5 Serial I/O and Cassette Interface	110
H8-13 Extended BASIC in Cassette Format	10
H9 Video Terminal	530
ECP-3801 Cassette Recorder/Player	55

If purchased separately, \$1550.00

Heath System price is **\$1472⁵⁰***



SYSTEM THREE

The minimum recommended H11 system

H11 Computer	\$1295
H11-1 4K Memory	275
H11-2 Parallel Interface	95
H11-5 Serial Interface	95
H9 Video Terminal	530
H10 Paper Tape Reader/Punch	350

If purchased separately, \$2640.00

Heath System price is **\$2508⁰⁰***

SYSTEM FOUR

SAVE EVEN MORE on this specially-priced Heath HS-11 complete computer system!

H11 Computer	\$1295
H11-1 4K Memory	275
H11-2 Parallel Interface	95
H11-5 Serial Interface	95
H10 Paper Tape Reader/Punch	350
H36 LA36 DEC Writer II	1495

If purchased separately, \$3605.00



\$3350⁰⁰*

YOU SAVE \$255!

NEW HEATHKIT SELF-INSTRUCTIONAL COMPUTER COURSES

These Heathkit self-instructional courses are designed to help you get the most from your computer investment, whether you buy your computer hardware from Heath or anywhere else. While many pre-developed software programs are available, the only way to realize the full value of your personal computer is to learn programming yourself. These courses use the PROVEN Heathkit individual learning techniques to give you a thorough understanding of programming, even if you have no prior knowledge or experience. They'll show you exactly how to make your personal computer system really personal!



BASIC PROGRAMMING SELF-INSTRUCTIONAL COURSE

This course teaches you how to program your computer using the popular BASIC language. BASIC (Beginner's All-Purpose Symbolic Instruction Code) is essential for hobby and personal computing; it is also widely used in education and business. The course covers all formats, commands, statements and procedures plus the creative aspects of computer programming, so you can make practical use of it in solving problems and creating your own unique programs. Like other Heathkit self-instructional courses, it uses programmed instructions backed by practical hands-on computer experiments and demonstrations to reinforce and personalize the text material. An optional final exam (passing grade 70%) brings you a Certificate of Achievement and 3.0 Continuing Education Units*. While the BASIC course is keyed to Heathkit computers, it is also equally applicable to any computer system using BASIC. Available after Oct. 20th, 1977.

EC-1100, Shpg. wt. 6 lbs.29.95

*Continuing Education Units (CEU's) are nationally recognized means of acknowledging participation in non-credit adult education.

COMING SOON!

8080 Programming: Teaches you the machine and assembly language used with 8080-based computers. Shows you how to use the editor, assembler and debug software to create efficient programs. Ideal for the H8 and other 8080A based machines. Coming soon.

LSI-11 Programming: Shows you how to use editor, assembler, linker, debug and executive I/O software to create efficient programs. Applicable to H11 and most other Digital Equipment Corporation PDP-11 series computers. Coming soon.



COMING IN OCTOBER!

MICROPROCESSOR SELF-INSTRUCTIONAL COURSE

Learn how microprocessors operate and how to design with them. Covers applications, machine language programming, hardware I/O interfacing and much more. The course includes all IC's needed to perform exciting experiments. The microprocessor trainer used with the course features the popu-

lar 6800 microprocessor plus 256 bytes of RAM, a 1K ROM monitor, 6-digit hexadecimal display and hexadecimal keyboard. The Heathkit microprocessor course/trainer combo is the fast, easy low-cost way to learn about these important devices. Watch for it in our next catalog!

GENERAL COMPUTER BOOKS

Microcomputer Dictionary and Guide (Matrix). Comprehensive source of definitions and basic information on computers and related topics. A super reference source. A must for your library. **EDP-21817.95**

Introduction to Microcomputers Vol. I (Osborne). Excellent introduction to microcomputers and fundamental computer concepts. **EDP-2247.50**

Introduction to Microcomputers Vol. II (Osborne). Complete descriptions of all popular microprocessors, 8080, 6800, 6502, SC/MP, Z80, F8, 2650, etc. Good reference. **EDP-22512.50**

How to Buy and Use Minicomputers and Microcomputers (Sams). A fundamental text on mini/micro operation and application. **EDP-2279.95**

TV Typewriter Cookbook (Sams). Good text explaining I/O terminals, interfacing, etc. **EDP-2269.95**

8080 BOOKS

Build a library to support your H8 computer or any 8080 based machine.

Bugbook III (E & L). Superior reference source on 8080 interfacing and programming. Includes experiments. **EDP-23115.00**

Bugbook IIA (E & L). Serial I/O concepts and terminal interfacing. **EDP-2325.00**

8080 Programming for Logic Design (Osborne). Programming and Using the 8080 microprocessor. **EDP-2297.50**

8080 Software Gourmet Guide and Cookbook (Scelbi). Excellent source for 8080 programs and subroutines. **EDP-2289.95**

Practical Microcomputer Programming: 8080 (Northern Technology). Machine/Assembly programming concepts for the 8080. **EDP-23521.95**

6800 BOOKS

Great reference sources for your 6800 based computers.

6800 Programming for Logic Design (Osborne). Programming and using the 6800 microprocessor. **EDP-2307.50**

6800 Software Gourmet Guide and Cookbook (Scelbi). Excellent source of commonly used 6800 programs. **EDP-2339.95**

6800 Microprocessor Applications Manual (Motorola). Comprehensive review of typical 6800 applications, design solutions, etc. **EDP-24425.00**

6800 Microprocessor Programming Manual (Motorola). Programming principles and examples for the 6800. **EDP-24510.00**

H11/LSI-11/PDP-11 BOOKS

Here are several important reference sources to help you get the most value from your H11 Computer.

Minicomputer Systems: Organization and Programming (Prentice-Hall). Good basic text. Emphasis on the PDP-11. **EDP-23817.95**

PDP-11 Programming (Algonquin). A programmed instruction text teaching the concepts of PDP-11 operation and programming. **EDP-2395.00**

The Minicomputer in the Laboratory (Wiley). Operation, programming and applications of PDP-11 computers. **EDP-24619.50**

GENERAL PROGRAMMING AND APPLICATIONS BOOKS

Assembly Level Programming (Lexington). Good basic book on assembly language programming of small computers. **EDP-23614.95**

101 BASIC Computer Games (DEC). A classic. Have fun with your computer. **EDP-2377.50**

BASIC Software Library, Vol. I. Complete lists of BASIC applications programs book-keeping, games, pictures (graphics). **EDP-24024.95**

BASIC Software Library, Vol. II. Math, engineering, plotting and statistical programs in BASIC. **EDP-24124.95**

BASIC Software Library, Vol. III. Advanced business applications programs in BASIC. **EDP-24239.95**

BASIC Software Library, Vol. IV. Games and business applications programs in BASIC. **EDP-2439.95**

BASIC Software Library, Vol. V. Games, graphics, and useful math programs in BASIC. **EDP-2519.95**

HEATH

Schlumberger

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Benton Harbor, Michigan 49022

ORDER FORM

Agreement

Gentlemen: Please send me the Heathkit Computer Products I have checked below. I understand that if I order products designated for future delivery Heath will do their best to ship within 30 days of those availability dates.

- ☐ H8 Computer at \$375.00 each plus \$5.40 shipping and handling.
- ☐ Qty. _____ H8-1 4K Memory(s) at \$140.00 each plus \$1.15 shipping and handling.
- ☐ Qty. _____ H8-3 4K Chip Set(s) at \$95.00 each plus \$1.15 shipping and handling.
- ☐ H8-2 Parallel Interface at \$150.00 each plus \$1.30 shipping and handling.
- ☐ H8-5 Serial I/O Cassette Interface at \$110.00 plus \$1.15 shipping and handling.
- ☐ H8-13 Extended BASIC Cassette at \$10.00 each plus \$1.15 shipping and handling.
- ☐ H8-14 Extended BASIC on paper tape at \$10.00 each plus \$1.15 shipping and handling.
- ☐ H8-15 Paper Tape Systems Software for H8 at \$20.00 each plus \$1.15 shipping and handling.
- ☐ HM-800 Manual Set at \$25.00 each plus \$2.37 shipping and handling.
- ☐ H11 Computer at \$1295.00 each plus \$5.52 shipping and handling.
- ☐ Qty. _____ H11-1 4K Memory(s) at \$275.00 each plus \$1.15 shipping and handling.
- ☐ H11-2 Parallel Interface at \$95.00 each plus \$1.15 shipping and handling.
- ☐ H11-5 Serial Interface at \$95.00 each plus \$1.15 shipping and handling.
- ☐ Please send the following Computer Books (order must total \$10.00 minimum) postpaid (Print numbers plainly.)

- ☐ H11-6 Extended Arithmetic Chip at \$159 each plus \$1.15 shipping and handling.
- ☐ HM-1100 Manual Set at \$25.00 each plus \$2.50 shipping and handling.
- ☐ H9 Video Terminal at \$530 each plus \$7.64 shipping and handling.
- ☐ H10 Paper Tape Reader/Punch at \$350 each plus \$4.96 shipping and handling.
- ☐ H10-2 Three Rolls Paper Tape at \$10.00 plus \$1.15 shipping and handling.
- ☐ H10-3 Three boxes Fan-fold Paper Tape at \$10.00 plus \$1.15 shipping and handling.
- ☐ H36 DEC Writer II at \$1495 (No COD's, see page 12 for shipping information.)
- ☐ H36-1 Fan-fold Paper at \$30.00 plus \$7.76 shipping and handling.
- ☐ H36-2 E1A Interface at \$65.00 each plus \$1.15 shipping and handling.
- ☐ ECP-3801 Cassette Recorder/Player at \$55.00 each plus \$1.69 shipping and handling.
- ☐ ECP-3802 Cassette Recording Tape. Pkg. of three at \$5.00 plus \$1.15 shipping and handling per pkg.
- ☐ EC-1100 BASIC Programming Course at \$29.95 plus \$1.69 shipping and handling. Available after October.
- ☐ HS-11 Special Priced Complete System at \$3350 each plus \$14.00 shipping and handling.

Note: The H11 and all its accessories will be available November 10th, 1977.

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You may purchase Heathkit products on our convenient Revolving Charge Plan. No money down and up to two years to pay. Up to \$1500 maximum account balance.

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Or charge to my ☐ Visa/BankAmericard ☐ Master Charge

Acc't No. _____ Exp. Date _____

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HEATH/DEC Software License Agreement:

This form MUST accompany your H11 computer order.

CUSTOMER SUBLICENSE GRANT

HEATH COMPANY (hereinafter referred to as HEATH) pursuant to a license agreement with Digital Equipment Corporation (hereinafter referred to as DIGITAL) does hereby grant to CUSTOMER a non-transferable and non-exclusive sublicense to use the Binary Software Program(s) PTSP-11 Paper Tape System, FOCAL/PTS Language Processor, BASIC/PTS Language Processor (hereinafter singularly and/or collectively referred to as "Software") on the following terms and conditions.

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HEATH COMPANY

By _____

William E. Johnson

CUSTOMER

By _____

Customer's Signature

Heathkit 15

To remove order form cut out entire page along dotted line.

Heathkit is the name to look for in quality electronic kits



Heath Company, located on the shores of Lake Michigan near Benton Harbor, is the world's largest manufacturer of electronic kits. Heathkit products are marketed primarily through the Heathkit Mail Order Catalog, published 5 times a year, and a nationwide chain of Heathkit Electronic Centers (Units of Schlumberger Products Corporation).



In addition to this new line of personal computing products, Heath Company offers nearly 400 other electronic kits of virtually every description. Product categories include Amateur Radio, Automotive Accessories, Stereo Hi-fi Components, Test Instruments, Color TV, Boating and Marine Accessories, Leisure and Home Improvement Products, and our award-winning self-instruction programs. Every Heathkit product is supplied with a comprehensive step-by-step instruction manual that tells you all you need to know, from unpacking the kit to plugging it in. These manuals are world-famous for their clarity, accuracy and precision. Let Heath show you how easily you can put together superior quality electronic products. Send for your FREE copy of our latest catalog!

Heathkit Computer Systems are also sold and serviced through 47 Heathkit Electronic Centers nationally (Units of Schlumberger Products Corporation) at slightly higher prices. Check the white pages of your telephone directory for the Heathkit Electronic Center nearest you.

Canadian Customers: Contact the Heathkit Electronic Center in most major cities or write for Canadian Prices to:

Heath Company, A Division of Schlumberger Canada, Ltd.
1480 Dundas Street E.
Mississauga, Ontario L4X 2R7

If you are using the SWTPC AC-30 cassette interface with a terminal that does not provide decoding of the device control codes (ASCII DC1, DC2, DC3, DC4), you must either start and stop tape units manually or connect the control lines directly to the MP-C PIA and provide special software to decode device control codes. Initially I had connected to the MP-C PIA, as the editor and assembler provided this software. The current versions of 4K and 8K BASIC do not provide these control routines, but assume instead that your equipment will decode the device controls.

Rather than modifying 8K BASIC or digging into the guts of my terminal to find device controls I decided to build a circuit to perform the decode function within the AC-30. This circuit uses a UART to convert the serial data from the MP-C control interface into parallel data and then two BCD-to-Decimal decoders to decode the desired control codes from the parallel data output of the UART (see Fig. 1).

Table 1 shows the device control codes, their values and uses. Note that these codes are normally associated with control of the paper tape reader and punch on a teletypewriter, however we are performing an equivalent job in control of cassette recorders.

The entire circuit can be built on a 2½ inch square circuit board and mounted inside the case of the AC-30. All but three of the external connections can be made through the AC-30 Control Connector (J4). These remaining connections can be soldered to the foil on the AC-30 circuit board.

Before installing the control decoder in the AC-30 check the voltage on the -13 volt line. (In my AC-30 it was 11.5 volts.) As the maximum

voltage from the +5 to -12 volt input of the AY-5-1013 is defined as 20 volts, anything up to about -14 should be OK. I expect that the UART will operate properly with a Vgg supply anywhere in the range of -10 to -14 volts. One other note; make sure you jumper Control Invert (J4-pin 8) to ground (J4-pin 2). The output of the control decoder is a positive pulse and this jumper sets up the AC-30 to expect this pulse.

Once installed, the MIKBUG L and P commands can be used to verify that the decoder is working properly. The following sequence will perform those tests.

1. Set memory locations A002 through A005 to 00 00 00 10.
2. Set both the record and read status switches on the AC-30 to their center position.
3. Enter a P on the control console. The record ready light should come on, one

Decoding Device Control Codes

... uses a UART, naturally

line of MIKBUG format dump should be displayed and then the record ready light should go out.

4. Enter an L on the control console. The read ready light should come on.

5. Enter an S9 on the control

console. The read ready light should go out.

If none of the functions work it is probably an error connecting up the UART. If a particular function does not work Table 1 should help in locating the error. ■

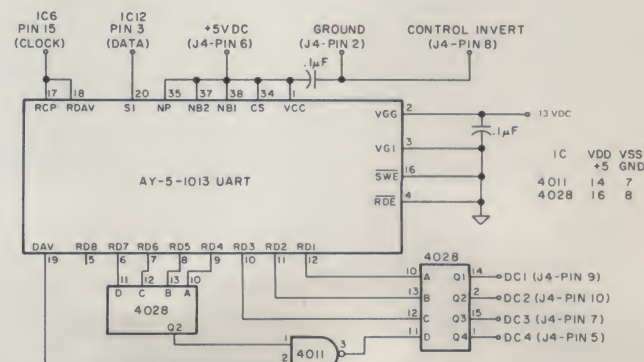


Fig. 1. Schematic of Device Control Decoder.

ASCII Code	Hexadecimal Value	Use	J4 Pin Number
DC1	11	Reader (Play) on	10
DC2	12	Punch (Record) on	9
DC3	13	Reader (Play) off	7
DC4	14	Punch (Record) off	5

Table 1. Device Control Codes.

Tarbell Asynchronous Format

... when you need a byte at a time !

```

: TITLE /ASYNCHRONOUS TARBELL CASSETTE ROUTINES/
:
: SUBROUTINE TO WRITE A BYTE TO CASSETTE
: DATA IS EXPECTED IN REGISTER A
:
:
: . PABS ; ABSOLUTE ADDRESSES
: . LADDR ; LIST WITH LO BYTE FIRST
:
4000 : . LOC 4000H ; LET'S START HERE
4000 4F ACW: MOV C,A ; SAVE THE DATA
4001 1610 MVI D,10H ; OUTER MODULO
4003 3E3C MVI A,3CH ; START BYTE
4005 CD2B40 CALL COUT ; OUTPUT START BYTE
4008 3EE6 MVI A,0EH ; SYNC BYTE
400A CD2B40 CALL COUT ; OUTPUT SYNC BYTE
400D 79 MOV A,C ; DATA BACK IN REGISTER A
400E CD2B40 CALL COUT ; OUTPUT DATA
4011 FE20 CPI ' ' ; LOOK FOR CONTROL CHR
4013 DA1940 JC .. A2 ; JUMP IF CONTROL CHR
4016 2A3740 LHLD .. A2 ; LOAD MODULO FOR ASCII
4019 D21F40 JNC .. A3 ; JUMP IF NOT CONTROL CHR
401C 2A3940 LHLD .. A3 ; LOAD MODULO FOR CONTROL
401F 7C MOV A,H ; REG H TO A
4020 B5 ORA L ; LOOK FOR ZERO
4021 2B DCX H ; DECREMENT INNER COUNTER
4022 C21F40 JNZ .. A3 ; LOOP IF NOT ZERO
4025 15 DCR D ; DECREMENT OUTER COUNTER
4026 79 MOV A,C ; DATA BACK IN REGISTER A
4027 C21140 JNZ .. A1 ; LOOP IF NOT ZERO
402A C9 RET ; DONE
402B F5 PUSH PSW ; SAVE THE DATA
402C DB6E IN 6EH ; GET STATUS OF TARBELL BOARD
402E E620 ANI 20H ; LOOK AT BIT 5
4030 C22C40 JNZ .. C1 ; LOOP IF NOT READY
4033 F1 POP PSW ; DATA BACK IN REGISTER A
4034 D36F OUT 6FH ; OUTPUT THE DATA
4036 C9 RET ; DONE
4037 2000 ASCMD: . WORD 0020H ; COUNTER MODULO FOR ASCII CHRS
4039 3000 CONMD: . WORD 0030H ; COUNTER MODULO FOR CONTROL CHRS
: . PAGE
:
: SUBROUTINE TO READ A BYTE FROM CASSETTE
: IN ASYNCHRONOUS FORMAT
:
:
4100 : . LOC 4100H ; START
4100 3E10 ACR: MVI A,10H ; RESET TARBELL BOARD
4102 D36E OUT 6EH
4104 DB6E IN 6EH ; INPUT STATUS OF TARBELL BOARD
4106 E610 ANI 10H ; LOOK AT BIT 4
4108 C20441 JNZ .. A1 ; LOOP IF NOT READY
410B DB6F IN 6FH ; GET DATA FROM THE TARBELL BOARD
410D C9 RET ; DONE
:
: ROUTINE TO READ FROM CASSETTE INTO MEMORY
:
:
4200 : . LOC 4200H ; START
4200 211000 LXI H,0010H ; STARTING MEMORY ADDRESS
4203 CD0041 .. C1: CALL ACR ; GET A BYTE FROM CASSETTE
4206 77 MOV M,A ; DATA INTO MEMORY
4207 23 INX H ; INCREMENT HL
4208 C30342 JMP .. C1 ; LOOP BACK
: . END

```

Fig. 1. TDL Z-80 Relocating Version 1.1, Asynchronous Tarbell Cassette Routines.

What if you had a piece of software which required you to output data to a paper tape punch (or some other asynchronous device) one byte at a time? Not too many of us have paper tape punches ... including Jim Gordon. Therefore, he came up with a technique for using his Tarbell Cassette Interface to fool that software (TDL Z-80 Assembler) into thinking it was sending data out to a punch.

(Incidentally, the single byte program was written using the Z-80 assembler but all the code is 8080.) — John.

Here's a new way to use your Tarbell Cassette Interface. In normal operation the interface is used to write a block of memory to cassette, or to read a block from cassette into memory. But what if you want to write one byte at a time, with any amount of time in between bytes, the way a paper tape punch does? This format will do that, and you can set the time between bytes to your own choosing.

It works like this: When it's time to write a byte, we send the Tarbell board a start byte, a sync byte, the data byte, and then pause a fraction of a second in a timing loop before going further. (Without the pause, the interface board won't write to tape correctly). Then the board is ready for the

next sequence; start byte, sync byte, data byte, pause, etc. Any amount of time can pass after the pause, because we're always starting a new sequence. I've found it handy to have two different length pauses; a short one following an ASCII character, and a slightly longer one following a control character. Two words are set up as a reference to control the length of the pauses. On my system the minimum to set each word is about 0020 hex.

By making the pause longer we can set it up so that a program that requires time between bytes may have it. (A program that needs time between bytes to search through a symbol table, for instance).

When reading a byte with this format, we send the

board a 6E to reset it, loop until ready, input the data byte, send out another 6E, loop, input a byte, send out another 6E, etc.

I'm using this with my TDL Z-80 assembler, which requires both a punch and reader that it can step one byte at a time. First I make the source listing with an editor and put it on cassette with the asynchronous format. Then I put it all into memory and use memory as a controlled reader. As the assembler makes its second and third passes, it makes a listing and then outputs object code. The cassette machine is again the punch, using the asynchronous format. Faster than paper tape, and cheaper than a floppy!

Notice that the routine to write into memory from the cassette is not a subroutine. It starts loading into memory at the starting address in H+L, and keeps on going until you stop it. ■

ACR	4100	ACW	4000	ASCMD	4037	CMR	4200
CONMD	4039	COUT	402B				

Fig. 2. Symbol Table.



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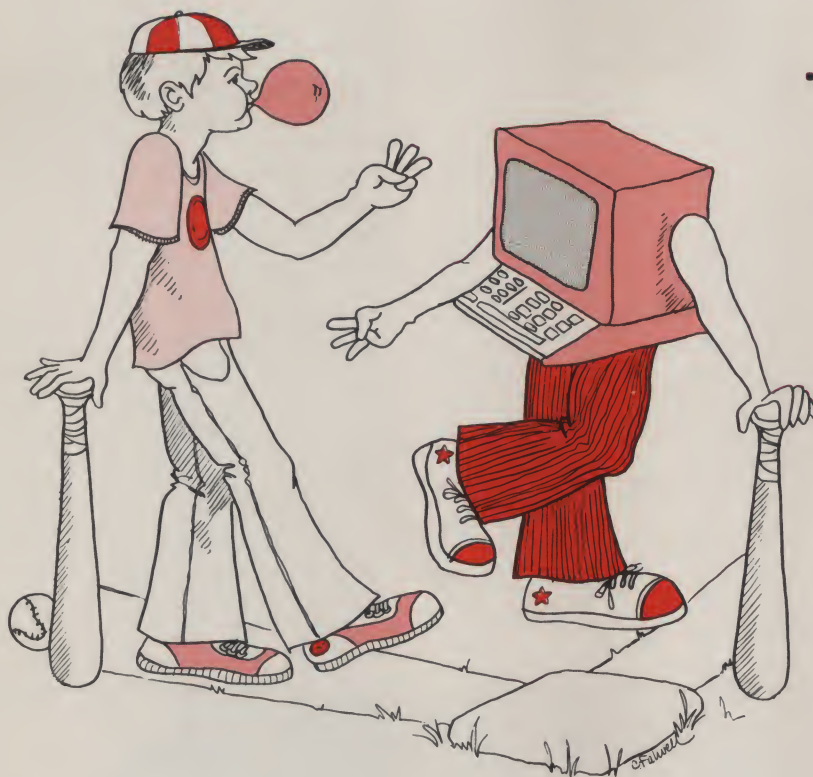
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Baseball in BASIC

... new twist for
an old game



Recently a friend of mine was playing a game with a young boy. It was a game which he invented years earlier to amuse his young son. He invented it at a time when computers were thought to do little besides messing up accounts and sending dunning letters. This game, as the title of the article indicates, is baseball.

Program listing.

```
0 REM          PROGRAM:  COMPUTER BASEBALL
                     IRWIN DOLINER (INTERACTIVE DATA SYSTEMS)
                     P.O. BOX 290
                     OWINGS MILLS, MARYLAND 21117

1 INPUT"WHAT IS YOUR NAME";N$
2 N$=N$+"S":PRINT:PRINT:PRINT:PRINT
3 PRINT"THIS IS A BASEBALL GAME BETWEEN THE "N$;" AND THE HEXADECES."
4 PRINT"WE ARE PLAYING FOR THE COMPUTER LEAGUE PENNANT SO PLAY YOUR BEST."
5 PRINT:PRINT:PRINT
10 DIM I(2,9),B$(5),T(5),S(2),B(5)
11 DIM T$(2)
20 MAT I=ZER
23 MAT T=ZER
26 S(1)=0
27 S(2)=0
30 INPUT"HOW MANY INNINGS SHOULD WE PLAY";I2
40 IF I2 > 0 AND I2 < 10 GOTO 50
45 PRINT"YOU MUST PICK A NUMBER FROM 1 TO 9":GOTO 30
50 F=INT(2*RND(3))
60 IF F=1 GOTO 90
70 PRINT "I'M THE VISITING TEAM"
71 T$(1)="** HEXADECES ARE UP **"
72 T$(2)="** "+N$+" ARE UP **"
80 GOTO 100
90 PRINT "YOU'RE THE VISITING TEAM"
91 T$(1)="** "+N$+" ARE UP **"
92 T$(2)="** HEXADECES ARE UP **"
100 PRINT "DO YOU NEED INSTRUCTIONS";
110 INPUT Y$
```

Two things intrigued me about this game. First, it was elegantly simple, but more important, it held the interest of the young player for quite a long time. The game is completely portable — the only equipment each player needs is four fingers.

To play the game the two players decide by choosing, tossing a coin or some other arbitrary means, which team is first at bat. Then, simultaneously, the two players each put out any number of fingers from zero to four. If they each display a different number of fingers the team at bat gets one out. But if they match, the team at bat gets the following:

No.	Team Gets
0	walk
1	single
2	double
3	triple
4	home run

Each player must then keep track of his base runners and how many runs he has scored.

Not being one to leave well enough alone, I have written a program which plays baseball according to the above rules. Of course I had to dispense with the fingers, since the computer hasn't any, and instead simulate them with random numbers. In addition to comments (attempts at humor) and aesthetic printing formats, one basic change was made in the number generation. The numbers zero through four are generated according to varying frequencies in an attempt at realism. The probabilities of generating the different numbers are as follows:

No.	Probability
0	.05
1	.50
2	.30
3	.10
4	.05

The game is simple to play, and a quick perusal of the sample run should give you an idea of what to expect. If instructions are required the program will produce them for you (lines 121-135).

As you play the game you will probably want to add some of your own refinements. Two changes which could be made come immediately to mind. Perhaps you would like to consider them. If the score is tied at the end of the specified number of innings, the program calls this a tie game. The program could be changed to play extra innings until there is a winner. Presently the bottom half of the last inning is played even if the home team is winning. This too could be changed to reflect what occurs in a real game.

Whether you change and personalize the game, or play it in its present form, I hope that you have fun with it. ■

```

115 IF Y$="N" GOTO 160
120 IF Y$="NO" GOTO 160
121 PRINT "WE EACH PICK A NUMBER FROM 0 TO 4. IF OUR NUMBERS MATCH"
122 PRINT "THEN WHOEVER IS AT BAT GETS WHAT THE NUMBER INDICATES, AS"
123 PRINT "FOLLOWS:"
124 PRINT
125 PRINT "NUMBER          RESULT"
126 PRINT "*****"
127 PRINT " 0          WALK"
128 PRINT " 1          SINGLE"
129 PRINT " 2          DOUBLE"
130 PRINT " 3          TRIPLE"
131 PRINT " 4          HOME RUN"
132 PRINT
133 PRINT "IF OUR NUMBERS DO NOT MATCH THEN THE TEAM AT BAT GETS"
134 PRINT "AN OUT — NATURALLY 3 OUTS RETIRE THE SIDE."
135 PRINT "OKAY? LET'S PLAY BALL"
136 PRINT
137 PRINT
160 B$(1)="WALK"
161 B$(2)="SINGLE"
163 B$(3)="DOUBLE"
164 B$(4)="TRIPLE"
165 B$(5)="HOME RUN !!"
166 B(1)=1
167 B(2)=1
168 B(3)=2
169 B(4)=3
170 B(5)=4
200 R=INT(5*RND(3))+1
210 ON R GOTO 220,240,260,280,300
220 PRINT "IT'S A BEAUTIFUL DAY FOR BASEBALL"
230 GOTO 310
240 PRINT "IT SURE LOOKS LIKE RAIN"
250 GOTO 310
260 PRINT "WE HAVE A CAPACITY CROWD TODAY — 40,000 FANS"
270 GOTO 310
280 PRINT "WHAT A POOR TURNOUT — ONLY 1,500 FAITHFUL FANS"
290 GOTO 310
300 PRINT "KEEP YOUR MIND ON THE GAME — NOT ON THE MINI-SKIRT IN THE FIRST ROW"
310 PRINT "THE GAME IS ABOUT TO BEGIN"
320 PRINT
330 FOR I3=1 TO I2
340 FOR H=1 TO 2
350 PRINT T$(H)
355 PRINT
360 O=0
400 X9=100*RND(3)
401 IF X9<05 THEN P(1)=0:GOTO 410
402 IF X9<55 THEN P(1)=1:GOTO 410
403 IF X9<85 THEN P(1)=2:GOTO 410
404 IF X9<95 THEN P(1)=3:GOTO 410
405 P(1)=4
410 PRINT "YOUR NUMBER";
420 INPUT P(2)
421 IF P(2)<=4 GOTO 425
422 PRINT "YOUR NUMBER MUST BE BETWEEN 0 AND 4 — TRY AGAIN"
423 GOTO 420
425 PRINT "MY NUMBER IS ";P(1)
430 IF P(1)=P(2) GOTO 480
440 O=O+1
442 IF O>1 GOTO 450
444 PRINT O;"OUT"
446 GOTO 460
450 PRINT O;"OUTS"
460 IF O=3 GOTO 600
470 GOTO 400
480 PRINT B$(P(1)+1)
485 T(1)=1
490 FOR I=1 TO B(P(1)+1)
500 FOR J=4 TO 1 STEP -1
510 T(J+1)=T(J+1)+T(J)
520 T(J)=0
530 NEXT J
540 NEXT I
550 GOTO 400
600 I(H,I3)=T(5)
610 S(H)=S(H)+T(5)
620 L=0
630 FOR I=1 TO 4
640 L=L+T(I)
650 T(I)=0
660 NEXT I
670 T(5)=0
680 IF H=2 GOTO 710
690 PRINT:PRINT "TOP ";
700 GOTO 720
710 PRINT:PRINT "BOTTOM ";
720 PRINT "OF INNING";I3
730 PRINT "SCORE: VISITORS";S(1);"HOME TEAM";S(2)

```



```

740 PRINT L;"LEFT ON BASE"
745 PRINT
750 PRINT
755 PRINT
760 NEXT H
770 NEXT I3
780 PRINT "FINAL SCORE: VISITORS";S(1);" HOME TEAM";S(2)
781 PRINT"INNING      1    2    3    4    5    6    7    8    9"
782 PRINT
783 PRINT USING "VISITORS  ## ## ## ## ## ## ## ## ## ##";I(1,1),I(1,2),I(1,3),I(1,4),I(1,5),I(1,6),I(1,7),I(1,8),I(1,9)
784 PRINT USING "HOME TEAM ## ## ## ## ## ## ## ## ## ##";I(2,1),I(2,2),I(2,3),I(2,4),I(2,5),I(2,6),I(2,7),I(2,8),I(2,9)
785 PRINT:PRINT
790 IF S(1)<>S(2) GOTO 820
800 PRINT"TIE GAME"
810 GOTO 900
820 IF F=1 GOTO 850
830 IF S(1)>S(2) GOTO 880
840 GOTO 860
850 IF S(1)<S(2) GOTO 880
860 PRINT "THE ";N$;" WIN!!"
870 GOTO 900
880 PRINT "THE HEXADECS WIN!!"
900 PRINT "PLAY AGAIN";
910 INPUT Y$
915 IF Y$="Y" GOTO 20
920 IF Y$="YES" GOTO 20
930 PRINT "THANKS FOR THE GAME — SEE YOU LATER"
940 PRINT:PRINT
980 END

```

RUN
WHAT IS YOUR NAME? IRV

THIS IS A BASEBALL GAME BETWEEN THE IRVS AND THE HEXADECS.
WE ARE PLAYING FOR THE COMPUTER LEAGUE PENNANT SO PLAY YOUR BEST.

HOW MANY INNINGS SHOULD WE PLAY? 3
I'M THE VISITING TEAM
DO YOU NEED INSTRUCTIONS? N
IT'S A BEAUTIFUL DAY FOR BASEBALL
THE GAME IS ABOUT TO BEGIN

** HEXADECS ARE UP **

YOUR NUMBER? 2
MY NUMBER IS 3
1 OUT
YOUR NUMBER? 1
MY NUMBER IS 2
2 OUTS
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 4
MY NUMBER IS 2
3 OUTS

TOP OF INNING 1
SCORE: VISITORS 0 HOME TEAM 0
1 LEFT ON BASE

** IRVS ARE UP **

YOUR NUMBER? 3
MY NUMBER IS 1
1 OUT
YOUR NUMBER? 2
MY NUMBER IS 1
2 OUTS
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 3
MY NUMBER IS 3
TRIPLE
YOUR NUMBER? 4
MY NUMBER IS 1
3 OUTS

BOTTOM OF INNING 1
SCORE: VISITORS 0 HOME TEAM 2
1 LEFT ON BASE

** HEXADECS ARE UP **

YOUR NUMBER? 1
MY NUMBER IS 0
1 OUT
YOUR NUMBER? 2

MY NUMBER IS 3
2 OUTS
YOUR NUMBER? 0
MY NUMBER IS 0
WALK
YOUR NUMBER? 2
MY NUMBER IS 0
3 OUTS

TOP OF INNING 2
SCORE: VISITORS 0 HOME TEAM 2
1 LEFT ON BASE

** IRVS ARE UP **

YOUR NUMBER? 2
MY NUMBER IS 1
1 OUT
YOUR NUMBER? 3
MY NUMBER IS 1
2 OUTS
YOUR NUMBER? 4
MY NUMBER IS 2
3 OUTS

BOTTOM OF INNING 2
SCORE: VISITORS 0 HOME TEAM 2
0 LEFT ON BASE

** HEXADECS ARE UP **

YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 3
MY NUMBER IS 1
1 OUT
YOUR NUMBER? 3
MY NUMBER IS 3
TRIPLE
YOUR NUMBER? 2

MY NUMBER IS 0
2 OUTS
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 3
MY NUMBER IS 0
3 OUTS

TOP OF INNING 3
SCORE: VISITORS 4 HOME TEAM 2
2 LEFT ON BASE

** IRVS ARE UP **

YOUR NUMBER? 4
MY NUMBER IS 2
1 OUT
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 3
MY NUMBER IS 3
TRIPLE
YOUR NUMBER? 2
MY NUMBER IS 1
2 OUTS
YOUR NUMBER? 2
MY NUMBER IS 1
3 OUTS

BOTTOM OF INNING 3
SCORE: VISITORS 4 HOME TEAM 3
1 LEFT ON BASE

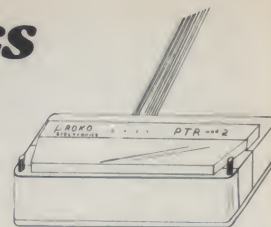
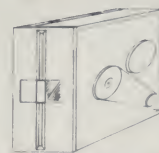
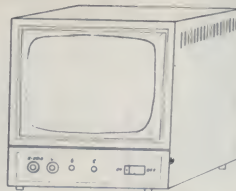
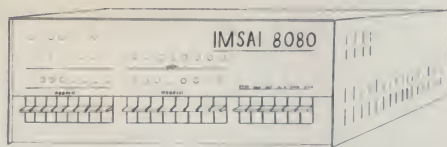
FINAL SCORE: VISITORS 4 HOME TEAM 3
INNING 1 2 3 4 5 6 7 8 9

VISITORS 0 0 4 0 0 0 0 0 0
HOME TEAM 2 0 1 0 0 0 0 0 0

THE HEXADECS WIN!!
PLAY AGAIN? N
THANKS FOR THE GAME — SEE YOU LATER

Sample run.

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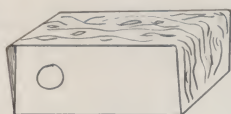
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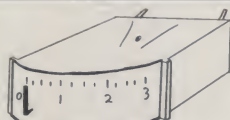
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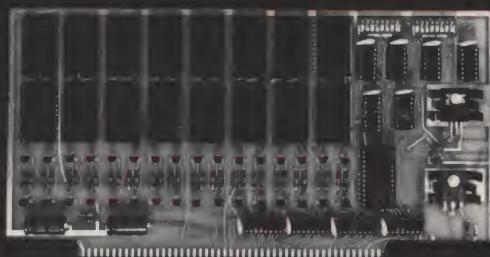
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MM-1 8KX8 fully buffered, S-100, uses 2102 type rams. PCBD\$30
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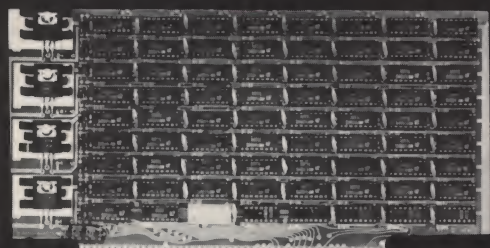
4KROM

[Read Only Memory]

- Will accept up to 16 ea. 1702A or 5203 EProm Providing up to 4096 Words of non-volatile memory for Boot Loaders to Complete Programs.
- Programming Available at Factory for \$3.00 per EProm when accompanied by binary formatted tape.
- Each 1702-A has its own V_{gg} clocked for Low power Consumption. Will work with the weakest power supply based S-100 buss computer.
- Switched Selected Address in 4K Blocks.
- Switch selected wait states so that even the slowest 1702-A can work in your system. 0-7 wait states
- Solder masked on both sides of PC Board.
- Component Screened on Component Side of PC Board.

Kit Price \$119.00

Assembled Price \$179.00



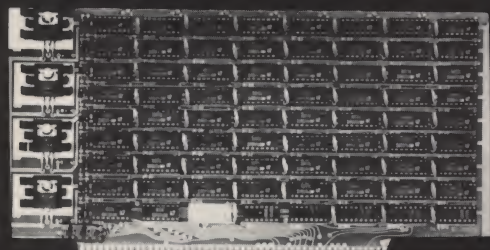
8KSC

[Static Memory Card]

- ALTAIR[®], IMSAI[®], and S-100 buss compatible.
- Access Time: 500 nsec max.
- Memory Chip: AMD 91L02APC or 2102AL-4
- Battery Standby: 1.5 to 4V
- Address Select: 8 ea. SPST Dip Switch
- Wait States: None
- Current Reg.: Less than 200 ma per 1K.
- All Address, Control, and Data Out lines fully buffered.
- All IC's supplied with IC Sockets
- Solder masked, both front and back of P.C. Board
- Component silk-screened on component side of card

Kit Price: \$269.00

Assembled Price: \$369.00



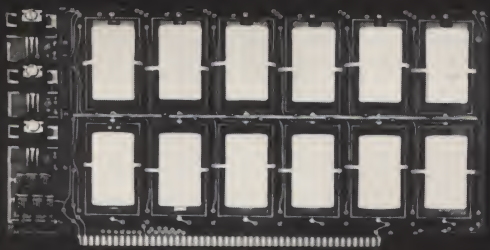
8KSC-Z

Same Specifications as for 8KSC Card Except:

- Access Time: 250 nsec max.
- Zilog Speed Compatible up to 4 mhz.
- Memory Chip: 2102LHPC or 2102AL-2

Kit Price: \$295.00

Assembled Price: \$395.00



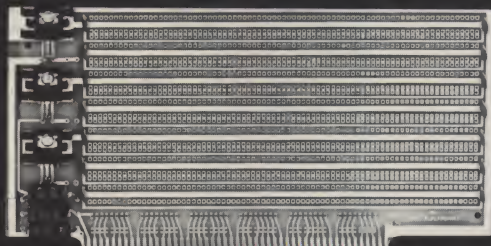
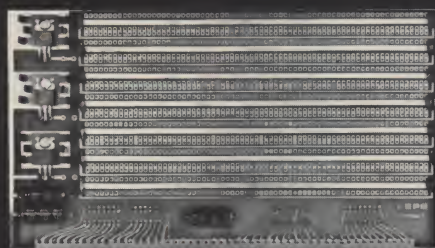
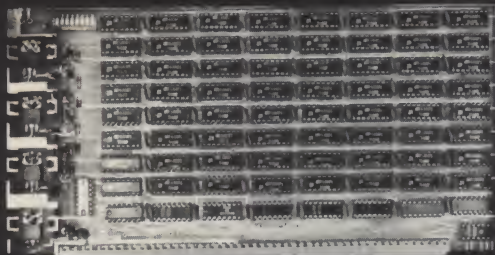
BBUC

[Battery Backup Card]

- Automatic Battery Charging Circuit
- Selectable Standby Voltage Outputs
- Will Hold up to 12 ea. "C" Cell Ni-Cad batteries
- The BBUC comes selected for 2.5 Volts Standby to Pin no. 14 on the Altair or S-100 buss structure to power up our 8KSC-Z Memory Boards.
- Can be Wired to Backup any Memory Card which has Battery Standby Capabilities.
- Eliminates cluge wires on top of memory boards. (Utilizes any vacant buss lines)
- Just Plug the BBUC into any available buss connectors.

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68KSC

[Static Memory Card for SWTPC 6800]

- 8192 Words of Static Memory
- Access Time: 500nsec. (250 nsec on request)
- Memory Chip 91L02 APC or 2102AL-4
- Battery Standby
- Address Selected 8 ea. SPST Dip Switch
- Low Power
- All Lines Buffered.
- All IC's with Sockets
- Solder Mask on both sides of PC Board

Kit Price \$269.00

Assembled Price \$369.00

68WWC

[Wire Wrap Card for SWTPC 6800]

- Contains all Buss Connectors
- Contains 3 ea. Voltage Reg. +12,-12,+5
- Contains 3 ea. 100 uf 35 Volt input Cap.
- Contains a generous supply of .1 12v decoupling capacitors.
- Will accept all popular IC wire wrap sockets 40,24,22,16,14,etc.
- Highest quality proto-typing board on the market today. It has all the basics. You just add your circuit.

Kit Price \$35.00

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68EXT

[SWTPC 6800 Compatible Products]

- 68 EXT-S-Small Maintenance Aid Raises any PC Board in SWTPC 6800 Computer.
- 68 EXT-L Maintenance aid to lift Large P.C. Boards above Computer to allow easy access while trouble shooting
- Pin numbers screened on Card
- Both Cards come with all connector hardware

Kit Price

68 EXT-S - Small \$19.00

68 EXT-L - Large 29.00

Assembled Price

\$25.00

39.00

88WWC

[Wire Wrap Card]

- Accepts All IC Sockets
- 3 Voltage Regulators +12, -12, +5V
- 3 Separate Input Capacitors
- Gold Plated Edge Contacts
- Component Layout Screened on Component Side of P.C. Card

Kit Price: \$37.50

Assembled Price: \$47.50

88EXT

[EXT Card] NOT SHOWN

- Maintenance Aid raises any S-100 buss PC Board above the computer to allow easy access while trouble shooting
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S22

Using an Invisible PROM

... how to relocate monitor programs

Jack Regula
2 Meadow Dr.
Freeville NY 13068

If you've ever experienced the frustration of not being able to load a particular piece of software because your monitor is sitting down in page zero, you're gonna love this! Jack has come up with a couple of simple cures for the problem... and the techniques should apply to Digital Group and other systems, as well as Altair bus machines. — John.

Most microcomputer users will agree to the desirability of having a monitor program in PROM that is

executed automatically at power-on. Such a program would initialize the system, then input the desired applications program from the cassette or other storage device (i.e., it would bootstrap the desired program in). It would also contain commonly used input/output subroutines and short routines to allow entering and debugging of machine language programs. With a monitor to allow entry and execution of high level commands at the terminal instead of low level commands at an Altair style front panel, you'll never key in another bootstrap loader. Modification of someone else's programs for your own use will be made much

simpler by the I/O subroutines stored in the PROM.

The Problem, and a Solution

The problem with a PROM monitor, as commonly conceived, is its incompatibility with hobbyist software. BASIC and many editor and assembler programs distributed through hobbyist channels execute in locations 0000 and up. Consequently, RAM must be located at the same addresses where the PROM would have to reside. This is because the reset, which occurs at power-on, causes the microprocessor to start executing the program stored at location 0000. Ideally, one would have PROM at this base address at power-on and RAM there afterward. Such a PROM would be there when needed, but invisible to the applications program.

A very simple technique can, in effect, change a microprocessor's reset vector (the address to which its program

counter is set by a reset) from 0000 to FC03 (hex). A schematic for accomplishing this is shown in Fig. 1. The output of a shift register temporarily disables the Tri-state buffer for the six highest-order bits of the address bus. Pull-up resistors make these bits 1s instead of 0s for the first three memory reads after a reset. This, in effect, jams a new reset vector, FC00, onto the address bus. As a result, the first instruction executed after reset is whatever is stored at FC00 (hex). If the instruction in FC00 is a JMP to FC03H, the program stored there (FC03 and up) will execute just as if the reset vector were to that same address.

Ah Yes, There's Another Way...

An alternate implementation shown in Fig. 2 involves modifying the memory boards rather than the CPU board. One gate forces a chip select to the PROM at FC00

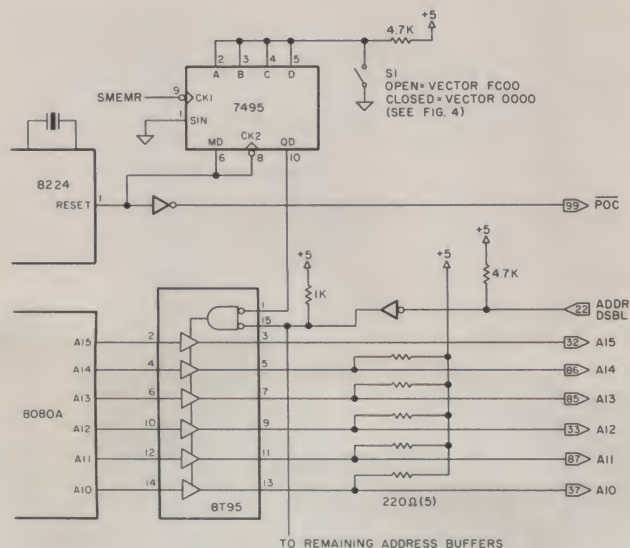


Fig. 1. Circuit to change reset vector by adding shift register and pull-up resistors and replacing the 8T97 with an 8T95. This should complete the modification for most CPU boards. (All mnemonics and connector pin numbers are for Altair bus.)

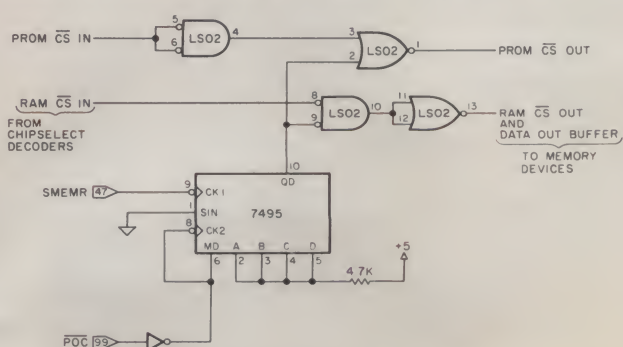


Fig. 2. Alternate invisible PROM ingredients involve modifying memory boards rather than the CPU board.

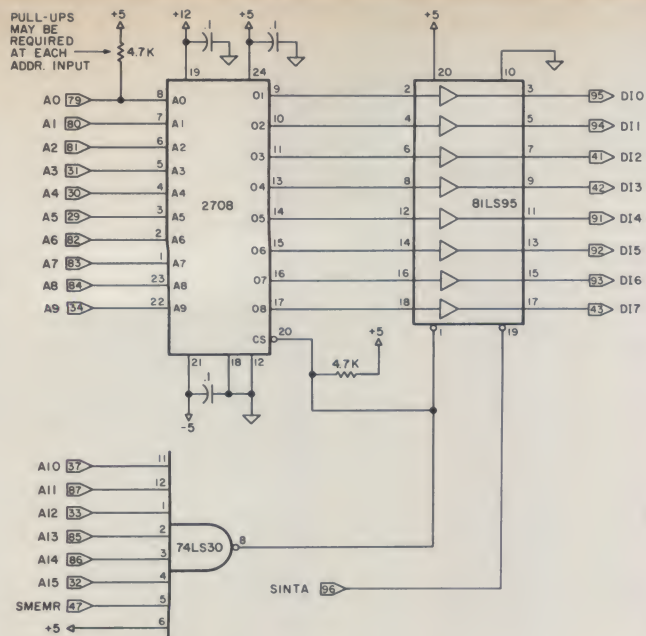


Fig. 3. Interfacing a PROM to the Altair bus. Data bus buffer can be shared with other PROMs or input ports on board.

whenever the shift register's output is high, while another prevents the RAMs at 0000 from receiving one. Note that for most (static) memory devices, delaying the chip

select as shown will not cause the access time to increase. Check your schematics to see which approach is easiest for you to implement.

The switch shown in Fig. 1

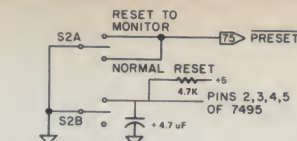


Fig. 4. Suggested reset switch wiring.

(S1) gives you a choice of reset vectors. With the switch closed, the system will work just as it did before modification. This will allow you to use your reset switch to restart BASIC, once you've managed to load it successfully. This suggests using a momentary action double-pole, double-throw toggle switch with a center off position for the reset switch. Pushing it up would jump you to the monitor. Pushing it down would get you to the program stored starting at 0000. Fig. 4 shows how to wire the reset switch.

Fig. 3 gives the fundamentals of wiring in a PROM. The address bus is connected to the address inputs of the PROM and to a 7430 NAND

gate which decodes a chip select. The Altair bus status signals SMEMR and SINTA are included in the logic function to prevent potential bus conflicts. Unless a bipolar PROM is used, you'll need the Tri-state buffer shown on the schematic. Consider the ultraviolet erasable 2704 and 2708 PROMs for this application. They're fast, easily programmed, and recent appearance of second sources should bring about a rapid price decline.

Unlike other techniques which change the address at which a chip select is decoded for the PROM, this PROM never moves, so its subroutines are available for use by other programs without relocation. Given its simplicity and ease of incorporation into just about any 8080 or Z80 based microcomputer system, there is little reason to delay wiring it in. Do so and the advantages of having an invisible PROM will be quite easy to see. ■

WHAT'S A BOPA?

ADDRESS	ROUTINE	CODE	MNEMONICS	COMMENTS
— 60		21	LXI—H	F800 Start Addr of Display
— 61	Clear	00		
— 62	Video	F8		
— 63	Display	36	MVI—M	A0 Load "Space"
— 64	Screen	AO		
— 65		7C	MOV A,H	Move high Address
— 66		FE	CPI	FC For Comparison
— 67		FC		
— 68		C8	RZ	Return When End
— 69				Of Screen Reached
— 6A		23	INX H	Next Display Addr.
— 6B		C3	JMP	OD53 Go to Load "Space"
— 6C		53		
— 6D		OD		
— 6E				
— 6F				
— 70				

Close-up of Board

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At the 1976 Atlanta Hamfest I was introduced to Technical Systems Consultants' fine software. Since I didn't have a computer, it didn't mean very

much to me at the time. But Robert Uiterwyk (who has written some super software himself) had nothing but praise for them. Since getting my own computer, I have

purchased more software from TSC than all other sources combined. Now, I have nothing but praise for TSC software!

The Klingon Capture game was one of the first programs I bought from TSC, and is still one of my favorite computer games. I have used it many times to demonstrate my computer system. Like all TSC software, Klingon Capture is written in assembly language. While this has the advantage of fast execution time and requires a minimal amount of memory to run, it also has a disadvantage or two. I have one version or another of BASIC in my machine virtually all of the time. This means that I lose BASIC when I load the Klingon Capture game into the machine (both use low memory) I then have to reload BASIC to do something else after playing the game. It seemed much less bother to write a version of the game in BASIC, so here it is.

In Klingon Capture, unlike Startrek, you don't want to kill the Klingon. To win, you must capture him alive. You do this by destroying all of the sectors surrounding the Klingon, leaving him nowhere to move. It isn't as easy as it sounds. You are never really certain where the Klingon is, because he may (or may not) have moved since the Battle Computer determined his last known position. And does he ever like to move! He can move in any direction, but only one sector at a time — very much like the king in chess. He cannot move out of the Quadrant, and he cannot move into a previously destroyed sector.

You have an (approximate) 5% chance of Supernovas appearing in the Quadrant or of being attacked by the Klingon. A Supernova destroys the sector in which it appears. Therefore it is very much like getting an extra shot, except the location of the Supernova is determined (at random) by the computer, not by you. A

```

10 REM      KLINGON CAPTURE
20 REM      BASED ON TSC'S 6800 MACHINE LANGUAGE GAME
30 REM      WRITTEN IN TSC'S MICRO BASIC PLUS
40 REM      BY
50 REM      MICKEY E. FERGUSON
60 REM
65 REM LINE 70 GETS YOU 15 — 20 SHOTS
70 S=RND/5:IF S < 15 THEN 70:IF S > 20 THEN 70
80 PRINT:INPUT "INSTRUCTIONS (YES=1) "I:IF I <> 1 THEN 150
90 PRINT "YOUR MISSION, COMMANDER, IS TO CAPTURE A KLINGON BATTLE"
100 PRINT "CRUISER. YOU MUST NOT DESTROY THE KLINGON, BUT TAKE IT ALIVE."
110 PRINT "TO CAPTURE THE KLINGON, YOU MUST DESTROY ALL SECTORS"
120 PRINT "SURROUNDING IT. THE BATTLE COMPUTER WILL KEEP YOU INFORMED"
130 PRINT "OF ITS LAST KNOWN POSITION. GOOD LUCK AND REMEMBER THAT"
140 PRINT "WE ARE COUNTING ON YOU, COMMANDER."
150 PRINT:PRINT "YOU HAVE ";S;" SHOTS.":PRINT
155 REM INITIALIZE QUADRANT
160 DIM Q(9,9)
170 FOR X=0 TO 9:FOR Y=0 TO 9:Q(Y,X)=0
180 Q(0,X)= -1:Q(9,X)= -1:Q(Y,0)= -1:Q(Y,9)= -1:NEXT Y:NEXT X
185 REM LINES 190 — 200 GET KLINGON'S INITIAL POSITION
190 X=RND/10:IF X < 1 THEN 190:IF X > 8 THEN 190
200 Y=RND/10:IF Y < 1 THEN 200:IF Y > 8 THEN 200
205 REM PRINT KLINGON'S "PRESENT" POSITION
210 PRINT "KLINGON'S LAST KNOWN POSITION, SECTOR ";X;" , ";Y:PRINT
215 REM MOVE KLINGON (MAYBE)
220 IF S <= 0 THEN 530:C=X:D=Y
230 A=RND/10:IF A < C THEN X=X-1:IF A > C THEN X=X+1
240 IF X < 1 THEN X=1:IF X > 8 THEN X=8
250 A=RND/10:IF A < D THEN Y=Y-1:IF A > D THEN Y=Y+1
260 IF Y < 1 THEN Y=1:IF Y > 8 THEN Y=8
270 IF Q(Y,X) <> -1 THEN 280:X=C:Y=D:GOTO 230
275 REM PRINT MAP
280 FOR A=1 TO 8:FOR B=1 TO 8
290 IF Q(B,A)= 0 THEN PRINT " ";
300 IF Q(B,A)= -1 THEN PRINT "0 ";
310 NEXT B:PRINT SPC(1):A:NEXT A
320 FOR A=1 TO 8:PRINT A:SPC(1):NEXT A:PRINT
325 REM CHECK TO SEE IF BEING ATTACKED (5% CHANCE)
330 A=RND/10:IF A > 4 THEN 370
340 PRINT "THE ENTERPRISE HAS BEEN ATTACKED."
350 PRINT "PHASOR ENERGY USED TO REPLENISH SHIELDS.":S=S-1
360 PRINT S;" SHOTS REMAIN.":PRINT
365 REM CHECK FOR SUPERNOVA (5% CHANCE)
370 A=RND/10:IF A < 4 THEN 420
375 REM LOCATE SUPERNOVA
380 A=RND/10:IF A=X THEN 380:IF A < 1 THEN 380:IF A > 8 THEN 380
390 B=RND/10:IF B=Y THEN 390:IF B < 1 THEN 390:IF B > 8 THEN 390
400 Q(B,A)= -1
410 PRINT "SUPERNOVA IN SECTOR ";A;" , ";B:PRINT
420 INPUT "YOUR SHOT (X,Y) ",A,B:S=S-1
425 REM CHECK IF YOU SHOT KLINGON
430 IF A=X THEN IF B=Y THEN 540
435 REM CHECK IF SECTOR HAS ALREADY BEEN SHOT
440 IF Q(B,A)= -1 THEN 580:Q(B,A)= -1
445 REM CHECK TO SEE IF YOU WIN
450 FOR A=X-1 TO X+1:FOR B=Y-1 TO Y+1
460 IF A=X THEN IF B=Y THEN 480
470 IF Q(B,A) <> -1 THEN 210
480 NEXT B:NEXT A
490 PRINT "CONGRATULATIONS! COMMANDER!"
500 PRINT "YOUR MISSION IS A SUCCESS! THE KLINGON HAS BEEN"
510 PRINT "CAPTURED AND YOU HAVE ";S;" SHOTS REMAINING!"
520 END
530 PRINT "PHASORS OUT OF ENERGY. NO SHOTS LEFT.":GOTO 560
540 PRINT "CONGRATULATIONS, DUMMY!"
550 PRINT "YOU JUST FRIED THE KLINGON!"
560 PRINT "YOUR MISSION IS A TOTAL LOSS!"
570 END
580 PRINT "NICE GOING, DUMMY!"
590 PRINT "YOU JUST SHOT A PREVIOUSLY DESTROYED SECTOR!"
600 GOTO 210

```

Program listing.

Klingon Capture Game

... bring 'em back alive !

Sample run.

\$RUN

INSTRUCTIONS (YES=1)?
0

YOU HAVE 17 SHOTS.

KLINGON'S LAST KNOWN POSITION, SECTOR 8,8

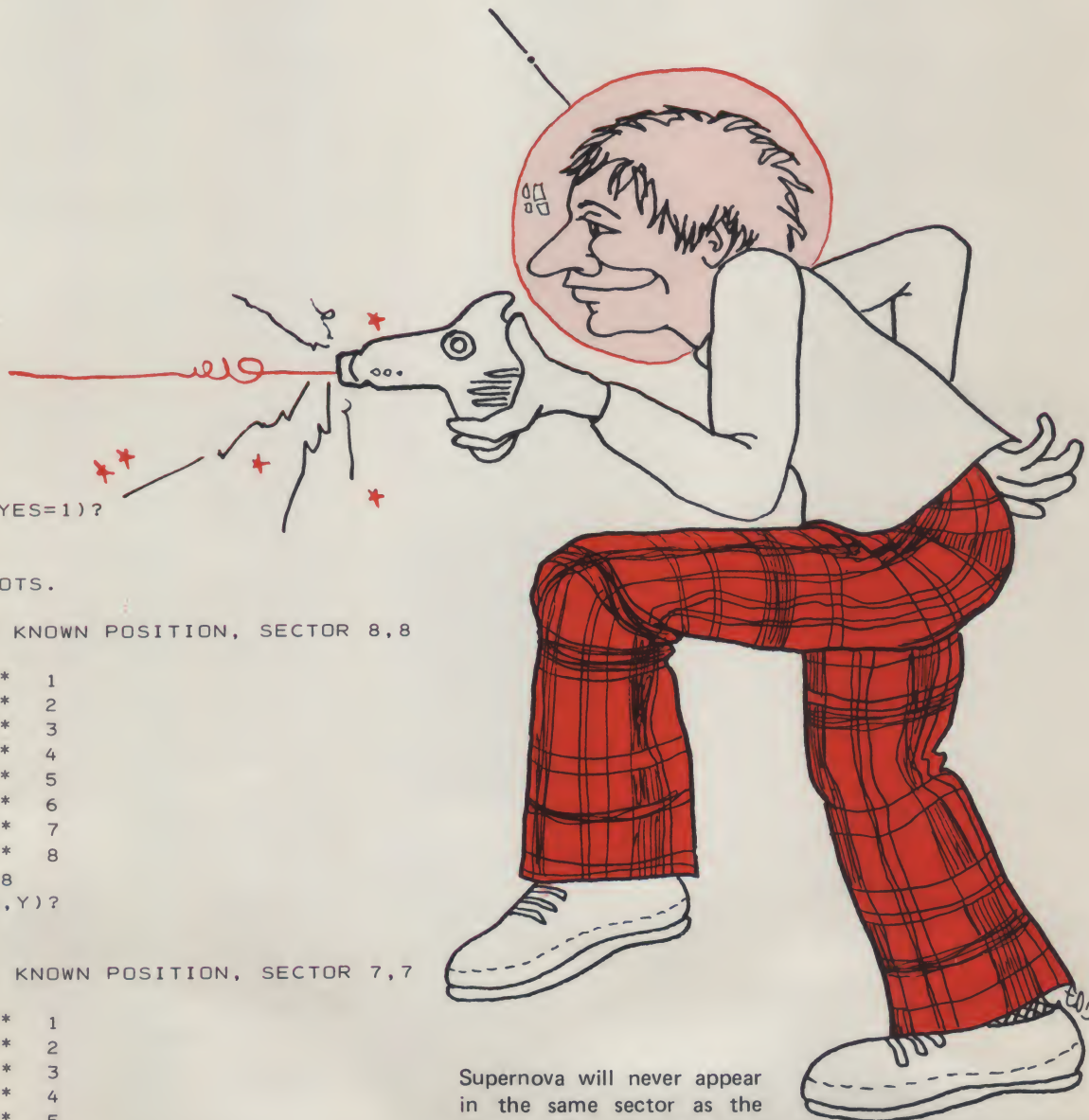
```

* * * * * 1
* * * * * 2
* * * * * 3
* * * * * 4
* * * * * 5
* * * * * 6
* * * * * 7
* * * * * 8
1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
5,5
    
```

KLINGON'S LAST KNOWN POSITION, SECTOR 7,7

```

* * * * * 1
* * * * * 2
* * * * * 3
* * * * * 4
* * * * 0 * 5
* * * * * 6
* * * * * 7
* * * * * 8
1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
6,5
    
```



Supernova will never appear in the same sector as the Klingon. If you are attacked by the Klingon, phasor energy will be used to replenish the ship's shields. This means you lose a shot. If the phasors run out of energy,

and you have not captured the Klingon, you lose the game. If you shoot the Klingon, you lose. Good hunting! ■

KLINGON'S LAST KNOWN POSITION, SECTOR 6,8

```
* * * * * 1
* * * * * 2
* * * * * 3
* * * * * 4
* * * * 0 * * * 5
* * * * 0 * * * 6
* * * * * * * * 7
* * * * * * * * 8
```

1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
5,8

KLINGON'S LAST KNOWN POSITION, SECTOR 7,7

```
* * * * * 1
* * * * * 2
* * * * * 3
* * * * * 4
* * * * 0 * * 0 5
* * * * 0 * * * 6
* * * * * * * * 7
* * * * * * * * 8
```

1 2 3 4 5 6 7 8
SUPERNOVA IN SECTOR 3, 8

YOUR SHOT (X,Y)?
5,7

KLINGON'S LAST KNOWN POSITION, SECTOR 8,6

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 * * * 6
* * * * * * * * 7
* * * * * * * * 8
```

1 2 3 4 5 6 7 8
SUPERNOVA IN SECTOR 6, 7

YOUR SHOT (X,Y)?
8,5

KLINGON'S LAST KNOWN POSITION, SECTOR 8,6

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 * 0 * 6
* * * * * * * * 7
* * * * 0 * * * 8
```

1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
7,5

KLINGON'S LAST KNOWN POSITION, SECTOR 8,7

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 * 0 * 6
* * * * 0 * * * 7
* * * * 0 * * * 8
```

1 2 3 4 5 6 7 8

YOUR SHOT (X,Y)?
6,6

KLINGON'S LAST KNOWN POSITION, SECTOR 7,6

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 0 0 * 6
* * * * 0 * * * 7
* * * * 0 * * * 8
```

1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
7,7

KLINGON'S LAST KNOWN POSITION, SECTOR 8,7

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 0 0 * 6
* * * * 0 * 0 * 7
* * * * 0 * * * 8
```

1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
8,7

KLINGON'S LAST KNOWN POSITION, SECTOR 8,8

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 0 0 * 6
* * * * 0 * 0 * 7
* * * * 0 * 0 * 8
```

1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
8,8

KLINGON'S LAST KNOWN POSITION, SECTOR 7,8

```
* * * * * 1
* * * * * 2
* * * * * 0 3
* * * * * 4
* * * * 0 * 0 0 5
* * * * 0 0 0 * 6
* * * * 0 * 0 * 7
* * * * 0 * 0 0 8
```

1 2 3 4 5 6 7 8
YOUR SHOT (X,Y)?
7,8

CONGRATULATIONS! COMMANDER!
YOUR MISSION IS A SUCCESS! THE KLINGON H
AS BEEN
CAPTURED AND YOU HAVE 6 SHOTS REMAINING!



ELECTRONICS

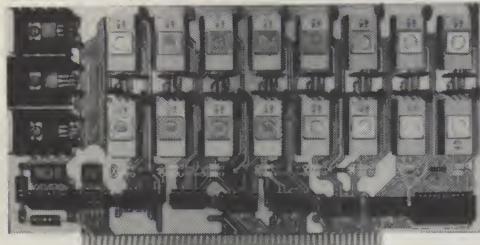
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Homebrew computing is, or soon will be, the great modern American cottage industry. It has all the characteristics: 1. widely available raw materials — kluge cards and chips and wire and solder, etc.; 2. modest capital investment; 3. labor-intensive; 4. any native may enter (perhaps after suitable rites of indoctrination and initiation).

It is expected that the industry will be characterized by a large number of small producers. The nature of the enterprise and the philosophy of the entrepreneurs resist transition to large-scale operations. At the same time, most computer hobbyists are willing to share — perhaps must share (witness the growth of clubs) their equipment and expertise.

The "Problem"

It is my observation that most computer hobbyists with entrepreneurial ambitions cannot work effectively on their own, and in fact they do not. This may reflect natural divisions in the industry. There are hardware types and software types, business types and creative types.

Consequently, I conclude that collaboration on a small scale is going to be a feature of the industry for some time to come. I am writing this to pass on some of my experiences with small-scale collaboration in the industry.

The following conversation is not entirely fanciful, and I think that many will be reminded of similar scenarios involving themselves or others they have heard about.

"Jack, I want to talk with you. I have heard that you just made a deal with IDM. Is that . . ."

"Oh, yes, Ed. They are going to put my disk controller into production and market it under their Homespun label. And I have also agreed to write some

supporting software for them. They gave me an advance on royalties."

"Congratulations, Jack. However, all that is part of what we have been doing together. You ought to have talked to me about it first."

"Oh, no, Ed. You and I talked about developing a cassette system. What I have been negotiating with IDM about is quite separate from our work. It is nothing to do with you . . ."

"But Jack, you have been using all my equipment to develop that board, and we have talked about the overall system quite often. We talked most about the cassette system only because we had agreed to give it priority. There was never any intention to make that our only project."

"Ed, you're wrong. I bought all the parts for the prototype board myself, and it was basically my idea."

"When we started to work together, Jack, our aim was just to develop products that would use the Pace chip. In my view, everything that either of us has worked on

since then belongs to both of us — even though I've put up most of the capital. You can't just decide that you'll have this piece and I'll have that piece."

"I don't agree at all, Ed. You just want to grab a piece of the action after I've done all the work. I might just as easily have done everything on my own."

Solution: Get it in Writing

The main point is that a misunderstanding or dispute like that just depicted is unnecessary.

Any time you work with other people, you should ask yourself, "Is this work being done for profit, or in contemplation of profit?" If the answer is yes, or perhaps even maybe, you should formalize the working and business relationship. It is not so much that the formalities will protect you; rather, they will force you and your collaborators to think about future contingencies and make the terms of collaboration explicit and mutually understood. Another reason for formalizing an apparently

business-like relationship is that you probably have a legal entanglement anyway, so you may as well plan it and control it properly.

Suppose you want to formalize the relationship and other people do not. My advice to you would be to terminate the existing work relationship. There are no good reasons not to have a formal relationship, so a refusal or reluctance to settle on one should be taken as a sign that a more serious disagreement will eventually surface. Trying to formalize a vague situation usually clarifies it. Clarifying who is supposed to do what, when and how is a valuable accomplishment for the people involved.

So, let us assume that you have agreed to put something in writing that will indicate a business relationship between you and some other people. The first decision is what kind of formal relationship to have, and that is essentially the choice between a general partnership and a corporation. How you choose will depend on your particular



Starting a Business ?

... pitfalls to avoid

situation, but I observe that most hobbyists collaborate on a casual basis and would not wish to organize a corporation until money was actually flowing. This suggests one possible solution to the problem of choice. Have a partnership until such time as a corporation becomes more desirable — until, for example, products are being sold. This contingency should be spelled out in the partnership agreement.

Rather than giving a list and discussion of the relative advantages of corporate and partnership forms of business, such as you might find in a business textbook, I will concentrate on taking an existing business relation and formalizing it as partnership. Then I will discuss some aspects of the corporate form of business organization. Since I live in California, as do a large number of *Kilobaud* readers, I am going to describe the California procedures. Other states will have similar procedures and regulations, but their actual burden varies significantly.

The Partnership

First, a general comment. At several points in this discussion I will suggest that you consult an attorney. A strong reason for not doing so is the expense but that is not

a sufficient reason. The fact is we live in a very complex society and personal computers are some of its most complex products. Rules of commerce are imposed whether we like them or not, and attorneys are the experts in this area. Because computer hobbyists may be the ultimate do-it-yourselfers, they probably need to be warned more than others that law is not a do-it-yourself proposition.

You may have a partnership already. A written agreement is not necessary to form a partnership. In some cases a partnership has been found to exist even when the partners had never discussed forming a partnership and later wished to deny that there had been a partnership. The basic test is whether the people intended to co-own a business for profit. The important consequences of being in a partnership are that the partners incur responsibility for each other's actions in connection with the partnership business and that each partner assumes a position of trust with respect to the interest of the other partners. Partnerships should clearly not be entered into lightly. Yet a casual cooperation engaged in with the intention of sharing ultimate profits will ordinarily be sufficient to create a partner-

ship.

Since you may have all the obligations and consequences of being a partnership anyway, it is better to plan the business relationship as soon as possible after you have entered into it, if not before. It is better to have the provisions you want rather than those that will be inferred from the circumstances or those imposed by general legal considerations.

To formalize a partnership, it is advisable to draw up and sign a partnership agreement, to choose a name, and to register the fact that you are doing business under that name.

The Partnership Agreement

The agreement should cover the important matters, and the prospect of signing the agreement will force the partners to decide what in fact are the important matters. Many misunderstandings will come out and, with luck, be settled. An agreement generally covers the purpose of the business, the capital to be contributed by each partner, the division of profits and losses, the form of accounting and the records and reports that are to be made, rules for the exercise of control and decision-making, and procedures for dissolution and transfer of a partnership interest.

You should think about the inevitability of change in the partnership. One of the major drawbacks of a partnership is that it is unstable. Unless provision is made for change in the membership of the partnership, the death of a partner, or withdrawal of a partner will automatically trigger the dissolution of the partnership, including a division of assets. A fair division of the results of a joint project is very elusive indeed. You can avoid this potentially destructive and contentious outcome by suitable provisions in the partnership agreement. The partnership should provide a method to appraise any partner's share and to enable the partnership or one of the remaining partners to buy out a withdrawing partner without the necessity of dissolution proceedings. Such agreements quickly become very technical. You should have the assistance of an attorney who is experienced in devising such provisions. If you can't afford an attorney something in writing is better than nothing.

It is prudent to acknowledge that disputes are probably inevitable, too. You should try to prevent disputes leading to lawsuits. It will help to head off trouble if you have at least three partners with control distributed so that a minority cannot control the decision-making. In the limit, with three partners, any two should be able to outvote the third. Thus, *de facto* control is effectively allied with social persuasion, tending to maintain a very stable system. Even so, disputes will still arise, and lawsuits may be contemplated. An alternative is binding arbitration, and the agreement can provide for binding arbitration for all disputes that cannot otherwise be settled. Arbitration can be a quite simple, fast and informal proceeding if care is taken to prescribe the form of arbitration in the agreement. One formula that

seems to work well is for each side to choose a representative, who then choose a third. They resolve the dispute, after investigation, by majority vote.

In small organizations personal property of members is usually donated. There is often vagueness or disagreement as to whether a transfer was a donation or a loan. The ownership of such personal property should be made explicit. With initial capital assets this can be done in the partnership agreement. Later donations should be entered immediately on the list of assets of the partnership, unless the asset is being temporarily loaned, in which case the terms should be noted in writing. You do not want Joe to quit and repossess "his" microprocessor or "his" scope unless everyone has agreed to this in advance.

Everyone should be warned that written documents do not prevent disputes, or necessarily help in settling them. People can and do break written as well as verbal agreements, and a verbal agreement is not

name of another organization, especially one in a similar business.

You must register your name with the County Recorder. The Recorder does not check to see whether the name you have chosen is already being used by some other concern. After becoming known by a particular name, you may have to give it up when the sound-alike company finds out about you.

Obtain a Fictitious Business Name Statement from the County Recorder, fill it out and register it — that is, give it back to the Recorder, who will keep it as an official record. The form is a simple one-page statement. It recites the basic facts that so-and-so are doing business as a partnership (in this case) under the name of such-and-such. Filing costs you \$10.

The fact that you are doing business under that name is supposed to be published in a newspaper of general circulation in your county. Several local papers check the county records and will probably contact you and offer to perform the

rating for your business.

When you open a bank account under a name that is not your own, the bank will want proper authority. If the business is not incorporated, the bank will have to be satisfied that a fictitious business name statement has been filed and published as required by law.

The Corporate View

Establishing a partnership is rather like getting married. The act establishes certain rules of ownership, sharing and mutual responsibility. The union, however, is more in the Moslem than the Christian mold, unless the partnership agreement is carefully devised so that the partnership can be dissolved only by mutual agreement.

On the other hand, establishing a corporation is more like giving birth. You create a new individual who has a life of her own. Her owners and controllers may change, but she will usually survive so long as any of the owners (shareholders) wish. A corporate form is more suitable for mature businesses. Its permanence is more appealing to certain entrepreneurs.

Many advisors will tell you that limited liability is a major advantage of the corporate form. In other words, your risk is limited to what your share of the company is worth. Your personal worth beyond that is not imperiled if your associates in the company incur a large liability. However, many people are in business without being incorporated and for a small enterprise the advantage of limited liability is largely illusory. Most corporate law denies the advantage of limited liability to an incorporator with insufficient assets; you cannot hide behind the corporate form.

State law largely governs corporate organization, and regulations vary from state to state. So, if you decide to incorporate, you have a choice of many different

states, or even foreign countries. Most hobbyists will want to incorporate, if at all, in their home state, and will have to follow the local regulations. Some may wish to incorporate in a state that is more hospitable to corporate interests. Delaware has such a reputation, and there is a popular book which gives the procedure and forms for incorporating in Delaware. Before the reader incorporates in another state, however, he should be aware of his home state's laws regarding the regulation and taxing of foreign (i.e., out-of-state) corporations. If you reside and do business in California, there is no longer any apparent advantage to having a foreign corporation.

Regardless of state, corporations are highly regulated. Statutes direct that decisions be made at meetings held at particular times, with required notice and numbers present, and under proceedings according to certain rules. Record-keeping and reporting requirements are specific and complex. The statutes are designed for running companies like Motorola, not Dick and Jane's Pong Palace. Fortunately, many states have special, less formal requirements for small corporations, or so-called "close corporations". California did not formerly have close corporations by statute, but it does now. The law provides special treatment for incorporation by a small number of owners (10 at most) who will govern the business through general agreements (written). The red tape that wraps a corporation has been minimized by the new law for small corporations, making such a form of organization seem much more suitable for the type of business we have been talking about.

Assuming that you have decided to incorporate, what do you do next? The procedures are similar for different states. I will describe the California regulations.

Since you may have all the obligations and consequences of being a partnership anyway, it is better to plan the business relationship as soon as possible . . .

necessarily less binding than a written agreement. The value of a written agreement is that its composition has forced the parties to think about all these matters, and indeed to have completed a successful negotiation.

Choosing a Name

Although you may choose any name for the partnership, it is advisable not to pick a name that is similar to the

service of publication.

Bank Account

You have a partnership agreement and a fictitious name duly registered with the county recorder. So now you are in business. You should open a bank account. Even if your account has very low volume, it establishes records for tax and general business purposes. It is important also that you create a good credit

The Incorporation Process

The new California Corporations law which went into effect on 1 January 1977 substantially simplified the procedure for incorporation. Minimal articles of incorporation can be written on one page. Everything else, such as election of directors and appointment of officers, may be done through the by-laws.

The Secretary of State administers incorporation. You can obtain information and sample articles of incorporation from the Secretary of State, 111 Capitol Mall, Sacramento CA 94814, (916-445-1768). You can find out over the phone (916-322-2387) whether a particular corporate name is available (not yet in use). The Los Angeles office of the Secretary of State can provide some of these services.

A corporation pays a minimum of \$200 a year franchise fee. The first year's fee is payable at the time of incorporation. In addition, there is a \$65 filing fee. Therefore, it is possible, though perhaps not wise, to incorporate without benefit of professional assistance, for \$265. An attorney or business advisor will incorporate your business in a fairly standard package for \$200 to \$500 in addition to the state fees.

Your corporation exists from the time the articles are filed. However, the corporation must still issue shares. It is the Commissioner of Corporations, not the Secretary of State, who administers the law relating to issuance of shares. You must make sure that the offering and sale of shares is exempt from the burdensome qualifying and reporting requirements of federal and state securities laws. It is virtually impossible to do this without the services of an attorney, so you may as well engage one early in the process of incorporating.

Patent Your Product?

A prosperous company

creating high technology products should retain or frequently consult a patent attorney. A good patent attorney will be able to explain to an individual what is and is not patentable.

For example, the possible ways of connecting logic gates is finite, and anyone can connect them. If, however, a few logic gates are connected to perform some useful job, the combination is not necessarily unpatentable.

Regardless of your preconceived ideas about patentability, and of what the laws and regulations say, the best way to get a good impression of patentability is through a search of actual patents related to the product you have in mind. Patents are carefully cataloged and cross-referenced by the Patent and Trademark Office, and may be searched at any of the 22 libraries around the country.

The two in California are in the Los Angeles and Sunnyvale Public Libraries. And the main library is in Arlington, Virginia; patent searches may be conducted there too.

If you cannot get to the library (or even if you can), you can obtain an initial patent search for about \$200. Patent attorneys do this, but the person you employ does not have to be a patent attorney.

The Patent and Trademark Office itself is a source of valuable information on procedure. For information write to the Patent and Trademark Office, Washington, D.C. 20231.

A word of caution, though. You may spend more time and money on a patent than it is worth. Being first, and being in possession of essential difficult-to-obtain information is an attractive and business-normal alternative to patenting. A patent confers the right to damages if you prevail in a suit after someone steals your product; it does not guarantee that pirates will overlook your product. In cases where no

large amounts of money are at stake, litigation is impractical — see the final note of cautions, below.

Where to Get Help

There is a wealth of information available if you know where to find it: 1. Some libraries are very helpful. Sample forms of partnership agreements can be consulted in a law library or a good

applying an ounce of prevention. Indeed, one of my purposes here has been to reduce the probability of litigation and to dispel the false notion that litigation is suitable for settling disputes. Some people who have had little contact with courts think that litigation is a practical alternative. The main reason for the impracticality of litigation for most disputes is

Establishing a partnership is rather like getting married. The act establishes certain rules of ownership, sharing and mutual responsibility.

general library. 2. The Secretary of State's office is usually very helpful to callers. All procedural information is willingly given. 3. Valuable advice on running a small business is available, free, from the Small Business Administration. The SBA has offices in all large towns. One arm of the SBA is the Service Corps of Retired Executives. Since these people come from an active business background, they are very knowledgeable.

Of course, you don't have to do everything on your own. Apart from attorneys, there are small business consulting firms that will, for a fee, hold your hand and set up your partnership or corporation and arrange for proper accounting and reporting for a given period. For a small business, the cost of a one year contract is \$500-800. Look under "Business Consultants".

Final Note of Caution

Perhaps you are deterred by the prospect of getting involved with all these technicalities. Remember that having a court unravel your tangled affairs is going to be much more onerous than

its cost. In a dispute of the type depicted at the beginning of this article, the estimated cost of a suit, before trial was \$10,000. I feel safe in saying that most hobbyists cannot come up with that kind of bread for that kind of gamble.

Another problem with litigation is the difficulty and uncertainty in valuing intellectual and potential commercial products. Even when there is a working prototype, a litigant is more or less obliged to value it in accordance with his interest. At one extreme he says it is worth only the cost of components and construction time. At the other extreme, he says it is worth the present value of projected future profits. But what the jury will decide is not foreseeable.

The high cost and unpredictability of outcome make litigation unattractive, if not positively repellent. All the litigants in the majority of modest cases are bound to lose. Don't be discouraged. I'm not. Does anyone want to join me in marketing a do-it-yourself partnership kit with a microprocessor as a loss-leader? ■

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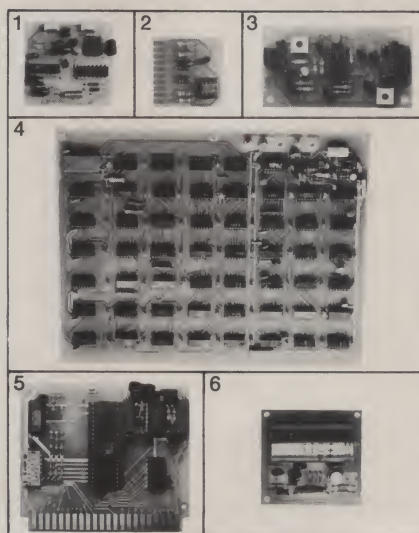
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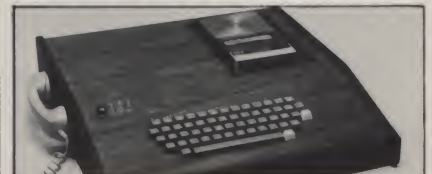
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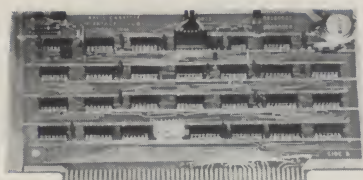
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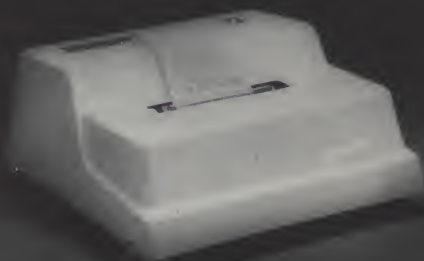
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21 005 000 000 RET
23 311
24
24 055 JMP EOLTS
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26 002 000 000
30 001 000 000
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34 247 ANA A
135 304 ENH
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'8080' OCTAL CODE CARD

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CNZ	A ≠ 0	304
CZ	A = 0	314
CNC	Cy = 0	324
CC	Cy = 1	334
CPO	Prty = Odd	344
CPE	Prty = Even	354
CP	Bit 7 = 0	364
CM	Bit 7 = 1	374

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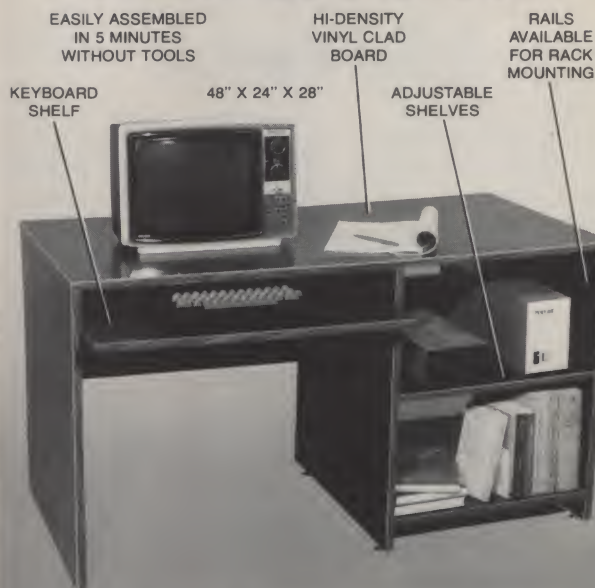
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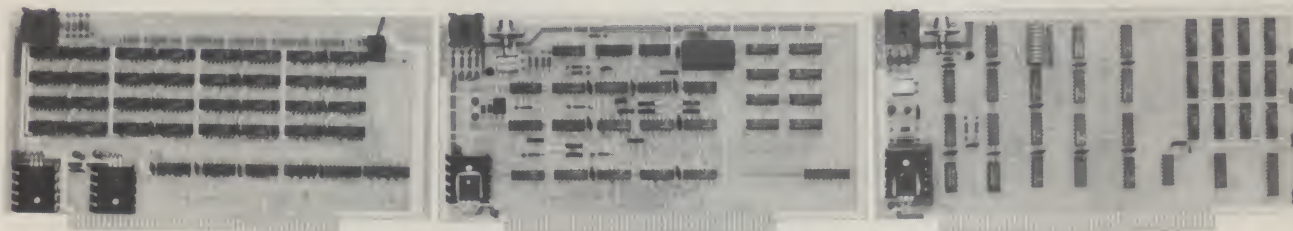
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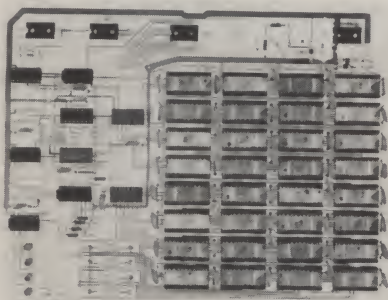


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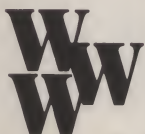
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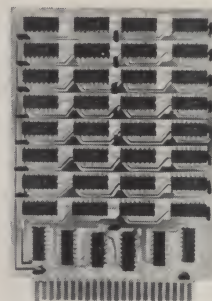


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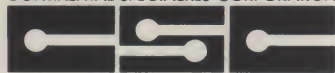
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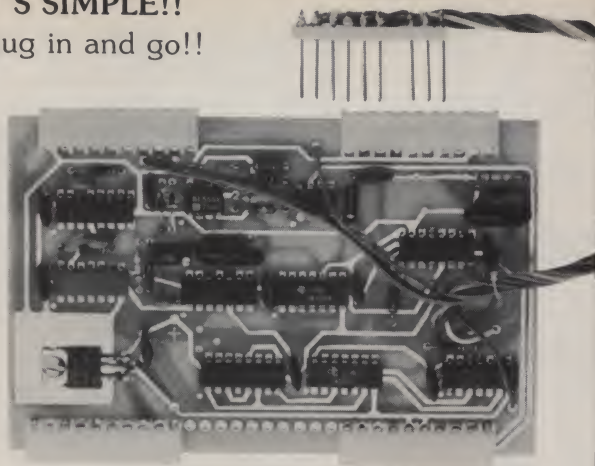
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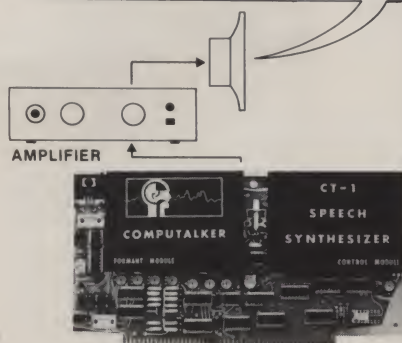


ACI-33 Cassette Interface

The ACI-33 is a greatly simplified audio cassette interface designed primarily for the Southwest Technical Products Corporation 6800, the control interface and a terminal. The unit will also operate with any RS-232 terminal and computer serial I/O. To use the interface it is only necessary to plug it into an unused I/O slot on the mother board (for power) plug the terminal which was connected to the control interface into the connector provided on the ACI-33 and the connector from the ACI-33 cable into the control interface connector. Priced at \$59.95 for an assembled model the interface is available from **Personal Computing Company**, 3321 Towerwood Drive Suite 101, Dallas, Texas 75234. Phone [214] 620-2776.

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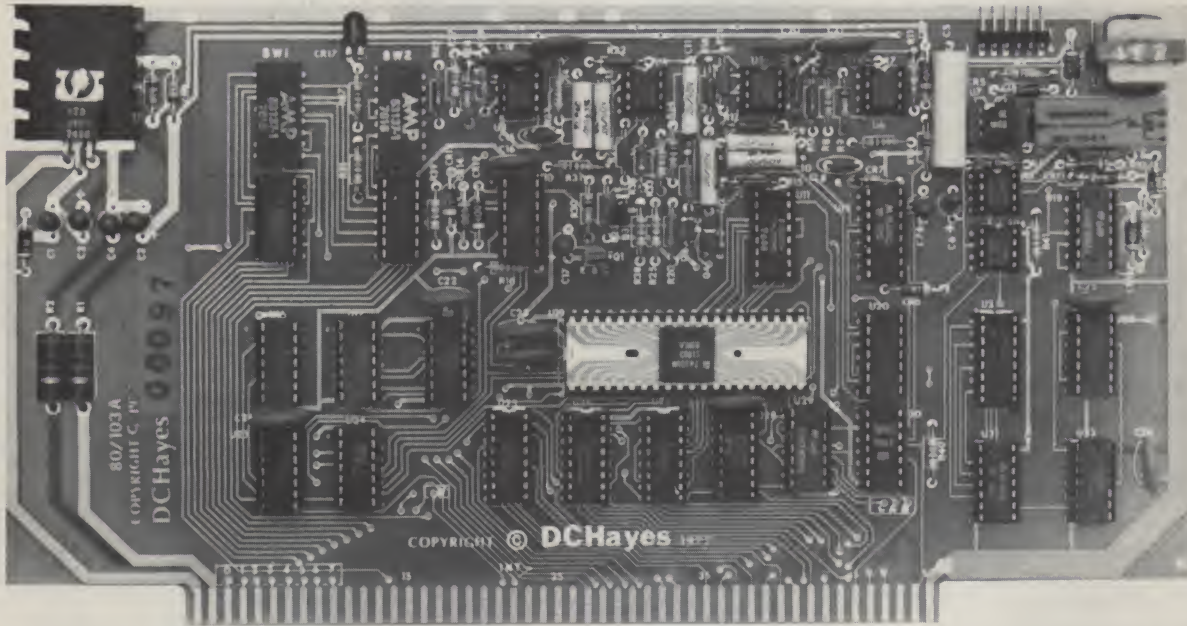
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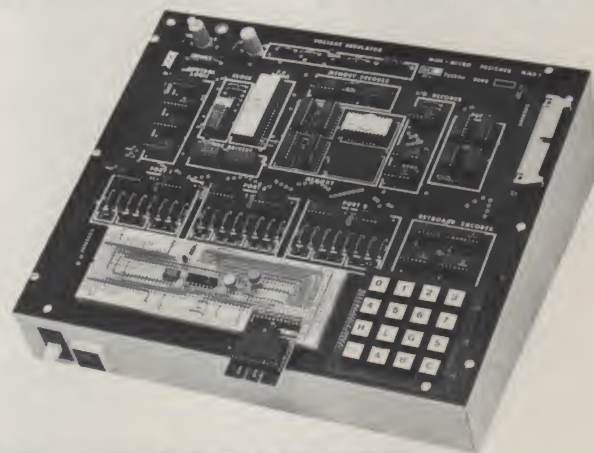
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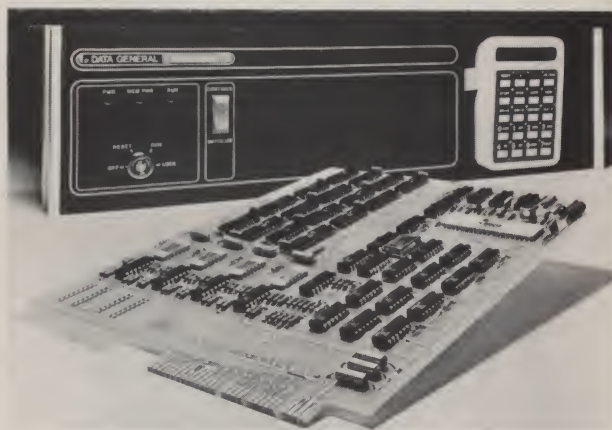
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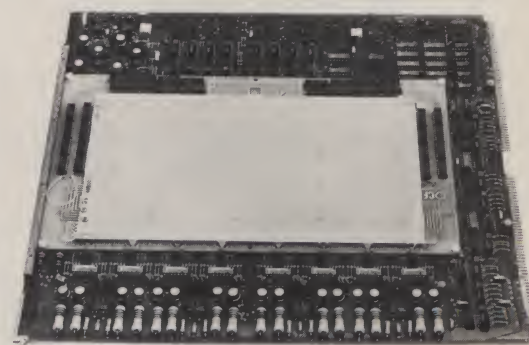
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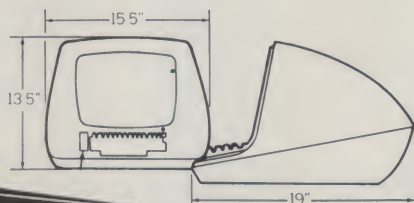
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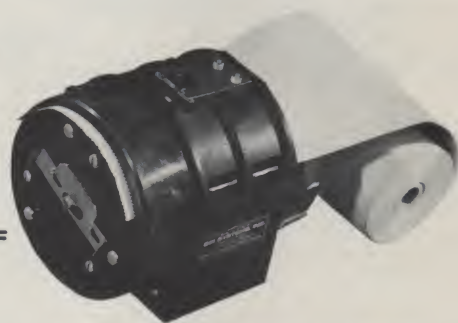
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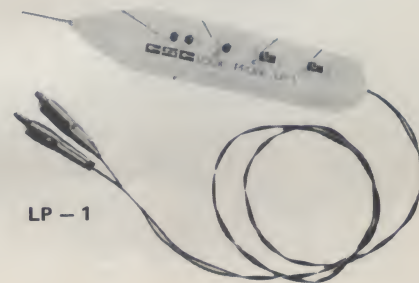
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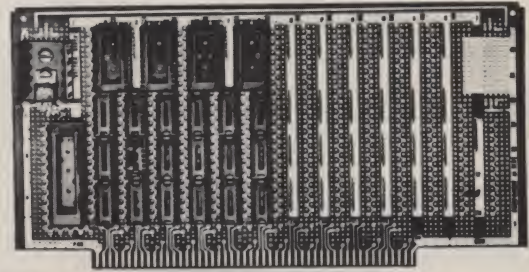
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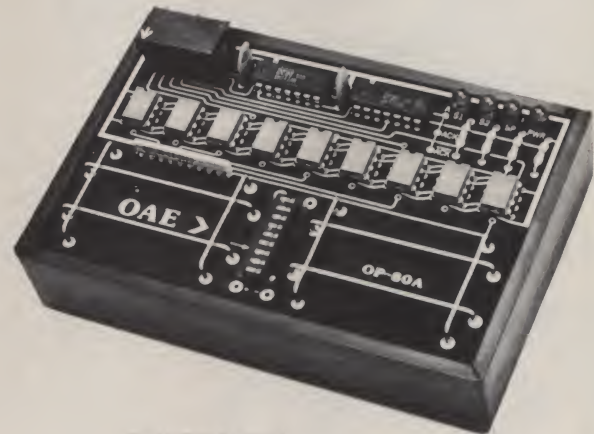
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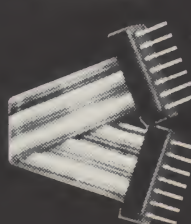
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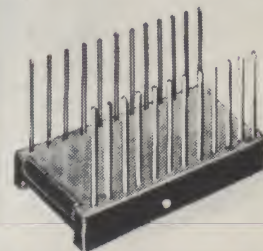


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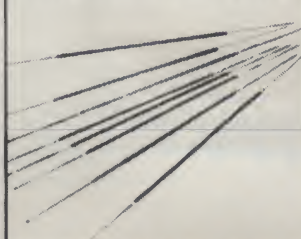
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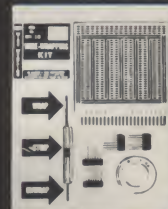


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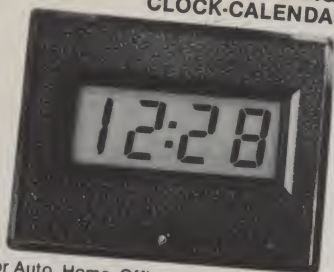
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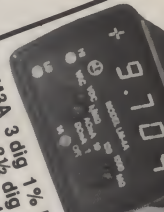
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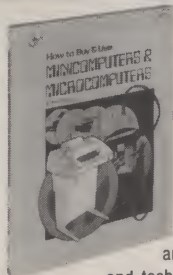
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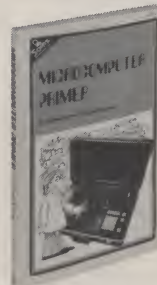
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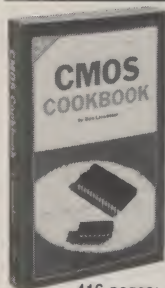
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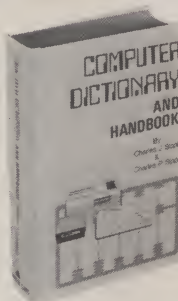


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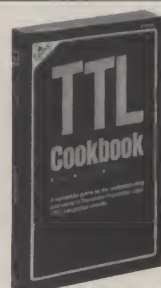


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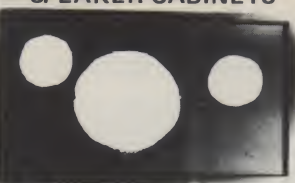
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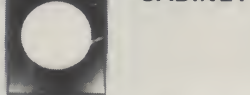
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4 pair for \$80.00 . . . \$80.00/4 pair

LARGE SPEAKER CABINET



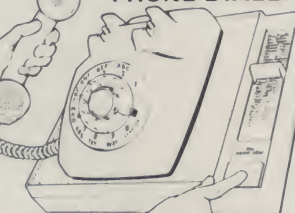
This enclosure was intended to go into a system that is renowned to be the most accurate medium priced speaker on the market. Size: 25 1/4" high x 15 1/4" wide x 9 1/4" deep. Cabinet will accommodate a 10" woofer, a 4 or 5" midrange and a 4" tweeter. Walnut grained vinyl exterior, black vinyl front face. Qty. Ltd., With data & grill cloth. Sh. Wt. 18 Lbs. ea.
70B70189 \$19.88 each
Pair for \$34.88 . . . \$34.88/pair

DIGITAL CLOCK/ALARM



New surplus clock alarm movement by General Time (Tally). This lighted digital movement was part of a clock/radio alarm, and has a 15 amp SPST switch to turn on radio (or whatever) at the time that you set. Numeral Height is 0.3". Overall dimensions are 5" wide x 3 1/8" deep x 2 1/4" high. Runs on 115V, 60 Hz.
Sh. Wt. 6 oz. . . . 7D70235 . . . \$4.00

"THE NAME CALLER" AUTOMATIC PHONE DIALER



Here's a neat item, brand new and packaged surplus. Great for business, home, baby sitters, people confined to beds, emergencies . . . or just as a convenience. Keep all your most-often-called numbers in memory at all times. Two models available: Home 2001 and Business 3001, (Business 3001 has 40 pin connector for multi-line phones). Sh. Wt. 12 Lbs.
Home 2001 . . . 7ZU70265 . . . \$28.88
Business 3001 . . 7ZU70266 . . . \$38.88

PHONE ORDERS WELCOME!

Bank Americard, Master Charge and American Express Accepted.
Phone: (617) 531-5774 / 532-2323
\$10.00 Minimum on Charge Orders

SEND ORDERS TO:
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Dept. K

119 FOSTER STREET
PEABODY, MA. 01960
(617) 531-5774/532-2323

TV TENNIS GAME KIT



1 or 2 players - 1 to 10 ball speed - dual paddle size - sound. These games were never finished at the factory. You do a little soldering and mounting to complete the work left undone. The IC board is already assembled and has passed Q.C. Just add some hardware to complete the project: a TV game for under \$10. Complete with instructions, qty. Ltd. Sh. Wt. 4 Lbs.
7ZU70250 . . . \$8.88 ea . . . \$69.99 for 10

DRINK MIXER KIT



Through a lucky purchase we obtained some new drink mixer parts. We have all parts except the top cover, but you can make your own or operate without it. Now you can build a \$20.00 mixer for under \$5.00. Great for shakes, kids love 'em. Includes motor, mixer, screws, line cord, stand, switch and 16 oz. mixer cup.
Sh. Wt. 5 Lbs. . . . 7M370053 . . . \$4.88
Spare MIXER CUP for above:
Sh. Wt. 8 oz. . . . 7M370054 . . . \$1.50 each

TOUCH-TONE GENERATOR CHIP



New, 2 of 8 encoder chip ME8900, (similar to the MC14410). Sold with data sheet on uses of MC14410 chip. No crystals required. Sh. Wt. 8 oz.
7VL70160 . . . \$6.95 ea . . . \$60.00 for 10

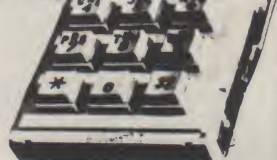
MM5240 STATIC CHARACTER GENERATOR CHIP

64 - 8x5 characters, 2,560-bit. With data.
Sh. Wt. 8 oz. . . . 7IC70231 . . . \$6.00 ea.

MEMORY CHIPS

PROM's: Mfg. by MMI & Signetics
† No. 6301, 1024 bit, 256x4, TTL, equal to Fairchild 93427C/M
Sh. Wt. 8 oz. . . . 7IC70173 . . . \$2.00
(Specify MMI-6301)
† No. 6306, 2048 bit, 512x4, TTL, equal to Fairchild 93446C/M
Sh. Wt. 8 oz. . . . 7IC70174 . . . \$2.00
(Specify MMI-6306)
† No. 82S126 Signetics, 1025 bit, 256 x 4 TTL, equal to Fairchild 93417C/M
Sh. Wt. 8 oz. . . . 7IC70175 . . . \$2.00
(Specify Signetics 82S126)

TOUCH-TONE CALLING KEYBOARD



New surplus boxed "ITT" keyboard, just the thing to make your own touch-tone phone or repeater. You can use these with our dialer chips ME 8900, MC 14410 or our Auto Dialer kit No. 6MI60189. Supplied with typical applications circuit diagrams.
Sh. Wt. 8 oz. . . . 7MI70162 . . . \$5.88
3 for \$17.00 . . . 7MI70162 . . . \$17.00/3
GTE (AE) Used Touch-Tone Keyboard
Sh. Wt. 1 Lb . . . 6MI60182 . . . \$5.00
Chorics Touch-Tone Keyboard - New
Sh. Wt. 8 oz. . . . 5MI00349 . . . \$4.50

B&F

Bearcat® 210

\$289.



Bearcat® 210 Features

- **Crystal-less**—Without ever buying a crystal you can select from all local frequencies by simply pushing a few buttons.
- **Decimal Display**—See frequency and channel number—no guessing who's on the air
- **5-Band Coverage**—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies
- **Deluxe Keyboard**—Makes frequency selection as easy as using a push-button phone. Lets you enter and change frequencies easily—try everything there is to hear.
- **Patented Track Tuning**—Receive frequencies across the full band without adjustment. Circuitry is automatically aligned to each frequency monitored.
- **Automatic Search**—Seek and find new, exciting frequencies.
- **Selective Scan Delay**—Adds a two second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency
- **Automatic Lock-Out**—Locks out channels and "skips" frequencies not of current interest.
- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor
- **Space Age Circuitry**—Custom integrated circuits—a Bearcat tradition
- **UL Listed/FCC Certified**—Assures quality design and manufacture.
- **Rolling Zeros**—This Bearcat exclusive tells you which channels your scanner is monitoring.
- **Tone By-Pass**—Scanning is not interrupted by mobile telephone tone signal.
- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion.
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

Bearcat® 210 Specifications

Frequency Reception Range

Low Band	32—50 MHz
"Ham" Band	146—148 MHz
High Band	148—174 MHz
UHF Band	450—470 MHz
"T" Band	470—512 MHz

*Also receives UHF from 416—450 MHz

Size

10 1/2" W x 3" H x 7 1/8" D

Weight

4 lbs. 8 oz.

Power Requirements

117V ac, 11W; 13.8 Vdc, 6W

Audio Output

2W rms

Antenna

Telescoping (supplied)

Sensitivity

0.6µv for 12 dB SINAD on L & H bands
U bands slightly less

Selectivity

Better than -60 dB @ ± 25 KHz

Scan Rate

20 channels per second

Connectors

External antenna and speaker; AC & DC power

Accessories

Mounting bracket and hardware
DC cord

The Bearcat® 210 is a sophisticated scanning instrument with the ease of operation and frequency versatility you've dreamed of. Imagine, selecting from any of the public service bands and from all local frequencies by simply pushing a few buttons. No longer are you limited by crystals to a given band and set of frequencies. It's all made possible by Bearcat spaceage solid state circuitry. You can forget crystals forever.

Pick the 10 frequencies you want to scan and punch them in on the keyboard. It's incredibly easy. The large decimal display reads out each frequency you've selected. When you want to change frequencies, just enter the new ones.

Automatic search lets you scan any given range of frequencies of your choice within a band. Push-button lockout permits you to selectively skip frequencies not of current interest. The decimal display with its exclusive "rolling zeros" tells you which channels you're monitoring. When the Bearcat 210 locks in on an active frequency the decimal display shows the channel and frequency being monitored.

With the patented track-tuning system, the Bearcat 210 automatically aligns itself so that circuits are always "peaked" for any broadcast. Most competitive models peak only at the center of each band, missing the frequencies at the extreme ends of the band.

The Bearcat 210's electronically switched antenna eliminates the need for the long low band antenna. And a quartz crystal filter rejects adjacent stations as well as noise interference.

Call toll-free 800-521-4414 now to place a BankAmericard or Mastercharge order. This is our 24 hour phone to our order department and only orders may be processed on this line. To order in Michigan or outside of the U.S. dial 313-994-4441.

Add \$5.00 for U.S. shipping or \$9.00 for air UPS to west coast. Charge cards or money orders only please. International orders invited. Michigan residents add tax. Please write for quantity pricing.

**COMMUNICATIONS
ELECTRONICS**

Box 1002
Ann Arbor, Michigan 48106 USA



DIODES/ZENERS

1N914	100v	10mA	.05
1N4004	400v	1A	.08
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.95
Molex pins	.01	To-3 Sockets		.25
2 Amp Bridge		100-prv		1.20
25 Amp Bridge		200-prv		1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN			.15
2N2907	PNP			.15
2N3740	PNP	1A	60v	.25
2N3906	PNP			.10
2N3054	NPN			.35
2N3055	NPN	15A	60v	.50
T1P125	PNP	Darlington		.35
LED Green, Red, Clear				.15
D.L.747	7 seg 5/8" high com-anode			1.95
XAN72	7 seg com-anode			1.50
FND 359	Red 7 seg com-cathode			1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	1.20
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.70
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.95
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	1.25
4044	.95
4046	1.50
4049	.80
4050	.60
4066	1.35
4069	.40
4071	.35
4082	.45

7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.45
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.35
7438	.35
7440	.25
7441	1.15
7442	.55
7443	.85
7444	.45
7445	.80
7446	.95
7447	.95
7448	.95
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.45

7473	.25
7474	.35
7475	.35
7476	.30
7480	.55
7481	.75
7483	.95
7485	.95
7486	.30
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.40
7494	1.25
7495	.60
7496	.80
74100	1.85
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	1.00
74150	1.00
74151	.75
74153	.95
74154	1.05
74156	1.15
74157	.65
74161	.85
74163	.95
74164	.60
74165	1.50
74166	1.35
74175	.80

- T T L -

74176	1.25
74180	.85
74181	2.75
74182	.95
74190	1.75
74191	1.35
74192	1.65
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.25
74H01	.25
74H04	.25
74H05	.25
74H08	.35
74H10	.35
74H11	.25
74H15	.30
74H20	.30
74H21	.25
74H22	.40
74H30	.25
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.25

74H72	.55
74H101	.75
74H103	.75
74H106	.95
74L00	.35
74L02	.35
74L03	.30
74L04	.35
74L10	.35
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.55
74S00	.55
74S02	.55
74S03	.40
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.25
74S50	.25
74S51	.45
74S64	.25
74S74	.40
74S112	.90
74S114	1.30

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257(8123)	.25
74LS00	.45
74LS01	.45
74LS02	.45
74LS04	.45
74LS05	.55
74LS08	.45
74LS09	.45
74LS10	.45
74LS11	.45
74LS20	.40
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.40
74LS40	.55
74LS42	1.75
74LS51	.65
74LS74	.75
74LS86	.75
74LS90	1.30
74LS93	1.00
74LS107	.95
74LS123	1.00
74LS151	.75
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.85
74LS368	.70

9000 SERIES

9301	.85
9309	.35
9322	.85
95H03	.55
9601	.75
9602	.50

MEMORY CLOCKS

74S188 (8223)	3.00
1702A	7.95
MM5314	3.00
MM5316	3.50
2102-1	1.75
2102L-1	1.95
TMS6011NC	6.95
8080AD	15.00
8T13	1.50
8T23	1.50
8T24	2.00
2107B-4	4.95

LINEARS, REGULATORS, etc.

8266	.35
8836	.95
MCT2	.95
8038	3.95
LM201	.75
LM301	.25
LM308 (Mini)	.75
LM309H	.65
LM309K(340K-5)	.85
LM310	1.15
LM311D(Mini)	.75
LM318 (Mini)	.65

LM320K5 (7905)	1.65
LM320K12	1.65
LM320T12	1.25
LM320T15	1.65
LM339	.95
7805 (340T-5)	.95
LM340T-12	1.00
LM340T-15	1.00
LM340T-18	1.00

LM340T-24	.95
LM340K-12	2.15
LM340K-15	1.25
LM340K-18	1.25
LM340K-24	.95
LM373	2.95
LM380	.95
LM709(8,14 PIN)	.25
LM711	.45

LM723	.50
LM725	1.75
LM739	1.50
LM741 8-14	.20
LM747	1.10
LM1307	1.25
LM1458	.95
LM3900	.50
LM75451	.65
NE555	.50
NE556	.95
NE565	.95
NE566	1.75
NE567	1.35
SN72720	1.35
SN72820	1.35

INTEGRATED CIRCUITS UNLIMITED

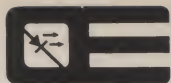
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NEW LSI TECHNOLOGY FREQUENCY COUNTER

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION (PORTABLE BATTERY OPERATION IS NOW PRACTICAL), DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!

SIZE:
3" High
6" Wide
5 1/2" Deep

1 3/4 LBS.
COLOR:
BLACK



4" DIGITS!

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
[AUTO DEC. PT. PLACEMENT]
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM $\pm .0001\%$ AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [0.01% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5.2 V DC AT 800 MA REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS
INPUT CONNECTOR: BNC TYPE

FACTORY DIRECT PRICES

KIT #FC-50 C	60 MHZ COUNTER WITH CABINET & P.S.	\$99.85
KIT #PSL-350	350 MHZ PRESCALER [NOT SHOWN]	23.95
KIT #PSL-650	650 MHZ PRESCALER [NOT SHOWN]	29.95
MODEL #FC-50WT	60 MHZ COUNTER WIRED, TESTED & CAL.	165.95
MODEL #FC-50/600 WT	600 MHZ COUNTER WIRED, TESTED & CAL.	199.95

KIT #FC-50 IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED. PRESCALERS WILL FIT INSIDE COUNTER CABINET.

PLEXIGLAS CABINETS



Great for Clocks or any LED Digital project Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I
3"H, 6 1/2"W, 5 1/2"D Black, White or Clear Cover
CABINET II
2 1/2"H, 5"W, 4"D \$6.50 ea

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea 4/13

SEE THE WORKS Clock Kit Clear Plexiglas Stand

- 6 Big 4" digits
- 12 or 24 hr time
- 3 set switches
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled
Kit #850-4 CP

Size: 6"H, 4 1/2"W, 3"D

\$23.50 ea 2/45.



ASUPER
CLOCK!

60 HZ.

XTAL TIME BASE
Will enable
Digital Clock Kits
or Clock-Calendar
Kits to operate
from 12V DC
1"x2" PC Board
Power Req. 5-15V
(2.5 MA TYP.)
Easy 3 wire hookup
Accuracy ± 2 PPM
#TB-1 (Adjustable)
Complete Kit \$4.95
Wir & Cal \$9.95

SPECIAL PRICING!

PRIME - HIGH SPEED RAM

21L02-3 400 NS

LOW POWER - FACTORY FRESH

1-24	\$1.95 ea	100-199	\$1.60 ea
25-99	1.75 ea	200-499	1.45 ea

OVER 500 PCS. \$1.39 ea.

6-DIGIT LED CLOCK CALENDAR KIT DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

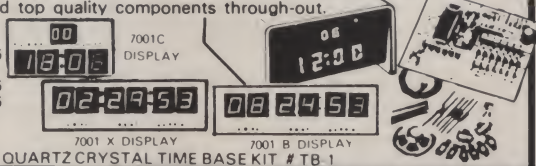
FOR THE BUILDER THAT WANTS THE BEST FEATURING 12 OR 24 HOUR TIME —
29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

KIT - 7001B WITH 6 - 5" DIGITS	\$39.95
KIT - 7001C WITH 4 - 6" DIGITS & 2 - 3" DIGITS FOR SECONDS	\$42.95
KIT - 7001X WITH 6 - 5" DIGITS	\$45.95

KITS ARE COMPLETE (LESS CABINET)

ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT #TB-1



PRINTED CIRCUIT BOARDS for CT 7001 Kits
sold separately with assembly info. PC Boards are
drilled Fiberglass, solder plated and screened
with component layout.

Specify for 7001

B, C or X - \$7.95

AUTO BURGLAR ALARM KIT

AN EASY TO ASSEMBLE AND EASY TO INSTALL
ALARM PROVIDING MANY FEATURES NOT
NORMALLY FOUND KEYLESS ALARM HAS
PROVISION FOR POS & GROUNDING
SWITCHES OR SENSORS WILL PULSE HORN
RELAY AT 1/2 RATE OR DRIVE SIREN. KIT
PROVIDES PROGRAMMABLE TIME DELAYS
FOR EXIT ENTRY & ALARM PERIOD. UNIT
MOUNTS UNDER DASH - REMOTE SWITCH
CAN BE MOUNTED WHERE DESIRED. CMOS
RELIABILITY RESISTS FALSE ALARMS &
PROVIDES FOR ULTRA DEPENDABLE ALARM
DO NOT BE FOOLED BY LOW PRICES! THIS IS A
TOP QUALITY COMPLETE KIT WITH ALL PARTS
INCLUDING DETAILED DRAWINGS AND IN-
STRUCTIONS OR AVAILABLE WIRED AND
TESTED



KIT #ALR-1

\$9.95

#ALR-1WT

WIRED &

TESTED

\$19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp
- KIT IS COMPLETE INCLUDING
DRILLED & SOLDER PLATED
FIBERGLASS PC BOARD AND
ALL PARTS (Less TRANS-
FORMER) KIT #PS-01 \$8.95
- TRANSFORMER 24V CT will
provide 300MA at 12V and
1 Amp at 5V. \$3.50

MOBILE LED CLOCK

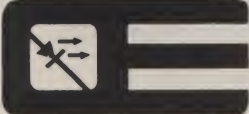
12/24 HR 4" DIGITS!

MODEL 12 VOLT AC or
#2001 DC POWERED



- 6 JUMBO 4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001
COMPLETE KIT \$29.95 3 OR \$27.95 115 VAC \$250
[Less 9V. Battery] EA MORE EA #AC-1
ASSEMBLED UNITS WIRED & TESTED
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MISCELLANEOUS

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XR-4136	99	XR-210	5.20
XR-1468	3.85	XR-215	6.60
XR-1488	5.80	XR-567CT	1.95
XR-1800P	3.20	XR-2208	5.20
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CONNECTORS

PRINTED CIRCUIT EDGE-CARD

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Bifurcated Contacts — Fits .054 to .070 P.C. Cards

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IMC 3 1/2 DIGIT DVM KIT

This 0-2 VDC .05 per cent digital voltmeter features the Motorola 3 1/2 digit DVM chip set. It has a 4" LED display and operates from a single +5V power supply. The unit is provided complete with an injection molded black plastic case complete with bezel. An optional power supply is available which fits into the same case as the 0-2 VDC DVM allowing 117 VAC operation.

A. 0-2V DVM with Case \$49.95

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0.1" Hole Spacing

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	169P44 02XXPP	4.50	17.00	3.69	3.32
	64P44 062	4.50	6.50	2.07	1.86
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	169P44 062	4.50	17.00	5.04	4.53
	169P44 062	8.50	17.00	9.23	8.26
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- ABCDEF
- Return Key
- Optional Key (Period)
- Key

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3080A 8 Bit MPU	26.50	2101 256 x 4 Static	5.95
		2102 1024 x 1 Static	1.75
		2107/5280 4096 x 1 Dynamic	4.95
		2111 256 x 4 Static	5.95
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		8101 256 x 4 Static	6.95
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		8599 16 x 4 Static	3.49
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2519 Hex 40 Bit	4.00
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Some applications are:

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- Tracing operation of control logic
- Checking counter and shift register operation
- Monitoring I/O sequences
- Verifying proper system operations during testing

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— Tracing operation of control logic

— Checking counter and shift register operation

— Monitoring I/O sequences

— Verifying proper system operations during testing

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QT-59B	QT-12S
QT-47S	QT-8S
QT-47B	QT-35S
QT-35S	QT-35B

QT type #holes price

QT-59S	590	12.50
QT-59B	bus strip	2.50
QT-47S	470	10.00
QT-47B	bus strip	2.25
QT-35S	350	8.50
QT-35B	bus strip	2.00
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by FAIRCHILD

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BRIGHT YELLOW ORANGE
3" x 1" LED DISPLAY!

Kit includes case, bracket and all components — complete
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Kit — \$39.95
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Elapsed Timer: Hrs, Mins and Secs
12 or 24 Hr Capacity
Simple Reset - Start Pushbutton Control

Complete kit includes mounting bracket, case and all components, nothing else to buy! Features MM5314 chip, Large 4" LED's. Accuracy better than ± min. per mo. internal battery backup 12 volt non-polar operation

DIMENSIONS: 4 1/2 x 4 x 2
12 or 24 HOUR MODE

Kit: \$29.95
Assembled: \$39.95

JE700 CLOCK

The JE700 is a low cost digital clock but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6 x 2 1/2 x 1. It utilizes a MAN72 high brightness readout, and the MM5314 clock chip

12 or 24 Hour
115 VAC

\$17.95

DIGITAL CLOCK KIT — 3 1/2" INCH DIGITS

4 DIGIT KIT \$49.95
6 DIGIT KIT \$69.95

4 DIGIT ASSEMBLED \$59.95
6 DIGIT ASSEMBLED \$79.95

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Specify 12 or 24 Hour When Ordering

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\$9.95 Per Kit
printed circuit board

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This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only \$9.95 Per Kit

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1702AL	256 x 8 Bit 1 us TS Eras Lo Pwr	7.00	NH0026CN	5 MHz Dual Mos Clock Driver	3.00	8080A	Super 8008	16.95
2704	512 x 8 Bit 450 ns TS Erasable	20.00	N8T20	Bi-Directional One Shot	4.00	Z80	CPU (3880)	39.95
2708	1024 x 8 Bit 450 ns TS Erasable	27.08	N8T26	Quad Bus Driver/Receiver	3.25	F8	CPU (3850)	19.95
3601	256 x 4 OC 70 ns	4.50	N8T97	Tri State Hex Buffer	1.45	CDP1802CD	CPU (RCA)	29.50
5203AQ	256 x 8 Bit 1 us TS Erasable	7.00	DM8098	Tri State Hex Inverter	1.00	DYNAMIC RAMS		
5204AQ	512 x 8 Bit 1 us TS Erasable	10.00	1488	RS232 Quad Line Driver	1.95	1103	1024 x 1 Bit 300 ns	1.50
82S23B	32 x 8 Bit 50 ns OC	4.00	3205	1-of-8 Decoder 18 ns Delay	6.20	2107B	4096 x 1 Bit 200 ns	4.50
82S129B	256 x 4 Bit 50 ns TS	4.25	D-3207A	Quad NAND to MOS Driver	2.50	2107B-4	4096 x 1 Bit 270 ns	4.00
8223B	32 x 8 Bit 50 ns OC	4.00	C-3404	6 Bit Latch 12 ns O/P Delay	3.95	4050NL	4096 x 1 Bit 300 ns	4.50
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8038	VCO	4.50	P-4201	Clock Generator	4.95	MM5262	2048 x 1 Bit 365 ns	3.00
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566	VCO-Function	2.00	MM-5369	Oscillator Pre-Scaler	2.00	5280	4096 x 1 Bit 200 ns (16 Pin)	6.00
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2513	5x7 5 line Lower Case	6.75	DM-8131	6 Bit Comparator	2.35	21L02-1	1024 x 1 Bit 350 ns TS	1.58
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16	Standard P.C. Tin	30
16	Wire Wrap 1 in	30
18	Lo Pin 1 in	25
18	Wire Wrap 1 in	85
20	Wire Wrap 1 in	95
22	Lo Pin (Open Frame) Tin	50
22	Wire Wrap 1 in	95
24	Standard P.C. Tin	50
24	Wire Wrap 1 in	85
24	Lo Pin (Open Frame) Tin	40
28	Lo Pin (Open Frame) Tin	40
28	Standard P.C. Tin	60
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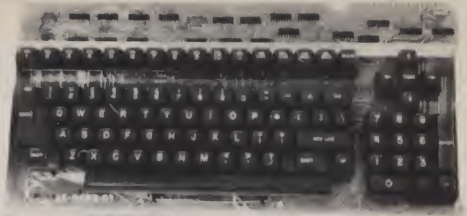
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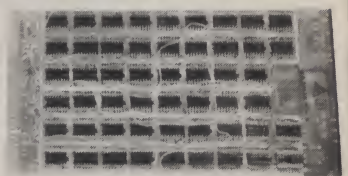
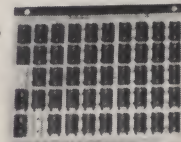
This is the TV interface device, described in the August issue of RADIO-ELECTRONICS. The VIDEOCUBE will interface video cameras, TV games, or the video output of mini and micro computers, to your TV set. FCC approved. Consists of a modulator and oscillator, which put the information on channel 2 of your TV set. We supply a reprint of the RADIO-ELECTRONICS article, and all necessary data. Kits come complete, with all parts, and partial with all hard to get parts, such as balun, coils, special feed thru caps, transistor, shield etc.

STOCK NO.5500 K, complete kit with data \$13.95 2/26.00

STOCK NO.5500RK, Partial kit, with data. \$11.95 2/22.00

WIRE WRAP PROTOTYPE BOARDS

Wire wrap boards for prototyping are expensive, running from \$25.00 for small boards, up to almost \$300.00 for the larger boards. They are ideal for prototyping, or making devices when a PC board is not practical. We have 3 boards, which came out of equipment, so the previous wiring must be removed. Using a wire wrap-unwrap tool, such as the OK tool, or VECTOR, this does not take long. Board 1 has from 75 to 100 sockets with mostly 14 pin sockets, some 16 pin sockets, and provision for adding 16 pin sockets if required. Board 2 has from 42 to 50 sockets, with provision for extra 16 pin sockets if needed. Board 3 has from 45 to 50 sockets, with the wire wrap pins brought out to the top of the board, so that all work can be done on the top of the board.



STOCK NO.6558K 75 to 100 sockets \$18.75 2/35.00

STOCK NO.6559K 42 to 50 sockets \$11.75 2/22.00

STOCK NO.6572K 45 to 50 sockets wire wrap pins on top \$12.75 2/24.00

REGULATED 5 VOLT & \pm 12 VOLT SUPPLIES

We have 2 very high quality regulated power supplies. Supply 1 is rated 5 volts @ 8 amps. is very highly regulated. .006%. This supply requires a 48 volt AC input, so we supply a 48 volt transformer with the supply. Supply 2 is a 5 Volt, 6 amp., and \pm 12 volts @ 2 amps. also \pm 6 volts @ 100 ma. These supplies have been removed from CODEX equipment, and are tested and guaranteed.

STOCK NO.5514K 5 volt 8 amp supply \$23.50 ea. 2/45.00

STOCK NO. 5519K 5 volt 6 amp. & 12 volt & 6 volts \$27.50 ea. 2/50.00

CRYSTAL OSCILLATOR BOARDS

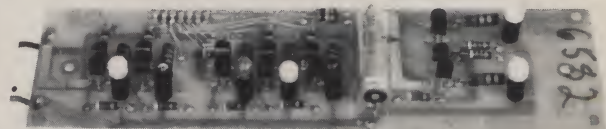
This board was used as the timing board on a CODEX Modem. It has a VECTRON CO-231T crystal oscillator, with tuning option for accuracy of .0001%. Crystal freq. is 4,9152 Mhz, which divides conveniently to many frequencies including 100 Hz, 60 Hz, 50 Hz and 1 Hz. We provide data showing how to get these



frequencies. VECTRON's current price for this oscillator is \$85.00. The board also contains many op amps, transistors, tantalum caps, series 7400 ICs, and much more. More than enough to make your own timing board or clock with a precision crystal oscillator.

STOCK NO.6560K Crystal Oscillator board \$16.95 2/32.00

INDICATOR BOARD



This small board, 6 1/2"x2" was used as an indicator board. It contains 7 miniature grain of wheat lamps, 5 volts @ 80 ma., sockets for these lamps, and plastic lenses of various colors that fit over the lamp to give a colored indication. The board also contains 14 2n3904 transistors used as drivers for the above lamps. New cost of lamp and socket was over .85 each when purchased. Ideal for parts, or as your own indicator board.

STOCK NO.6582K Indicator board \$1.50 ea. 4/5.00

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D13

TERMS: Prices good through 9/30/77. Orders under \$10 add 50¢. Please include up to 5% for shipping; excess refunded (may be more with item like power supply). Californians add tax. CODs accepted with street address.

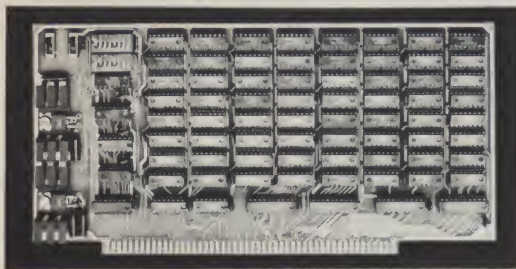
the GODBOUT GAZETTE

Bill Godbout Electronics
PO Box 2355 Oakland CA 94614

CREDIT CARD ORDERS/24 HOUR ORDER DESK: Place BankAmericard®/Mastercharge®/Visa® charge card orders (\$15 minimum) by calling (415) 562-0636, 24 hours. By the way, do you have our flyer? You probably should.

GODBOUT'S INTRODUCES 24K OF MEMORY FOR \$450; HOBBYISTS REJOICE!

INCLUDES STATIC DESIGN, TRI-STATE OUTPUTS, \$100 BUSS COMPATIBILITY



EXCLUSIVE TO THE GAZETTE

It is now possible to purchase three 8K Econoram IIT™ boards for \$450. A single 8K board, the fastest selling computer kit in Godbout's history, is still available for \$163.84.

"We wanted to make it possible for the computer hobbyists to stuff a lot of memory into their machines at a reasonable price", Bill Godbout is quoted as saying today. Judging from the response, he seems to have succeeded.

However, a representative for the company stressed that price was not the only attractive feature of this board, citing the low current consumption (1.5A guaranteed, 1250 mA typical) and high speed (0 wait states). For users of Z-80 processors driven by a 4 Mhz clock, there is even on-board logic for implementing 1 wait state.

He added, "the vector interrupt feature, which lets you know if you are trying to write

into protected memory, is very handy. Also, the board was designed to be configured as two, separately addressable 4K blocks which adds considerably to the versatility."

A poll of users, undertaken by Godbout's, shows that hobbyists are pleased by the all-static design, which eliminates dynamic timing problems. Others find the tri-state outputs, and fully buffered inputs and outputs, to be their favorite features. All agree that the quality is exceptional, from the legendary and solder masked board to the low profile sockets.

Those wishing to take advantage of the special \$3450 offer should ask for #SPC-24. The standard 8K board (\$163.84) is stock number CK-008; an assembled version, #CK-010, is available for \$188.50. A 4K version of the board costs \$100 in kit form (#CK-007) and \$120 assembled (#CK-009).

Energy Crisis Hits Home

Computer owners from coast to coast have complained of a lack of available energy for their computers. The problem lies not with power generating stations, but rather with the shortage of compact, low priced power supplies capable of providing the many voltages required by micro-processing systems. Experimenters also report being frustrated by the lack of power supplies.

However, the Gazette has confirmed existence of a solution to this energy crisis. Our highly placed source, nicknamed "deep volt", has leaked the following information about a "CPU Power Supply", also known by its stock number (#CK-014).

"The unit appears to be a well thought out supply, which delivers 5V @ 4A with crowbar over-voltage protection, along with ½ Amp of +12V and ½ Amp of -12V. A particularly sneaky feature is an adjustable 10 mA bias supply, required by some CPUs, that is often not included in other units. Those who say there are no economical power supplies for small systems are in for a shock as the price is a mere \$50.

"Despite rumors of a power supply energy crisis, with wildly inflated prices forced on a public with no other choice, it seems that the Godbout CPU Power Supply should lay these misconceptions to rest permanently."

MOTHERS SAFE FROM BUSS POLLUTION

Many motherboards have reported flu-like symptoms (coughing, sneezing, dropping bits, scrambling data) when loaded with more than a few peripheral boards. It seemed that these motherboards lacked antibodies capable of rejecting noise, crosstalk, overshoot, etc. This is commonly called "buss pollution".

However, it was discovered that a particular group of motherboards, located in the wilds of the Oakland Airport, had developed an immunity to buss pollution.

It seemed these motherboards had active termination circuitry, and that's what accounted for the difference. Old motherboards may be immunized by simply plugging in an Active Terminator Network (#CK-017, \$29.50).

Or, if you want a new motherboard, Godbout's has two --- both with active terminations, lots of bypass caps, and heavy PC board traces:

#CK-015, a 10/11 Slot Motherboard, comes with 10 edge connectors and is excellent for adding on to small systems. \$90.00

#CK-016, an 18 Slot Motherboard, includes 18 edge connectors and is ideal for starting a stand-alone system. \$124.00

Processor Prices Plummet

The workhorse 8080A, darling of the chip set, has reached a new low in pricing. Prime, new full spec units cost only \$12.95 regardless of quantity purchased when you order part #SPC-22.

In a parallel development memory prices continue to drop. Full speed 2708s are now available for \$25.00; order part #SPC-23.

COMPUTER STRIKE AVERTED

Things looked tough at the negotiating tables located at computer stores throughout the country. The heart of the problem was a common computer grievance: having to shuttle programs in and out of their RAMs, thus hampering their productivity, and tying up work for hours at a time. Computers also complained of abuse at the hands of owners, who became enraged when programs went down the drain if the power went off for even a split second.

When the Godbout team of negotiators arrived on the scene, the computers showed a new spirit of compromise. After all, many of them had Godbout memories inside their cases --- and computers are known for their loyalty.

The solution: the computers would go on working, if the owners plugged Godbout Econoram IIT™ boards into their systems. Then, they wouldn't have to worry about losing their minds if the power went away, because Econoroms hold programs and routines in erasable read only memory. So that owners wouldn't face undue hardship due to the extra expense Godbout's introduced several different boards, of various price levels and complexities. All of them feature 1K of static RAM as part of the memory; all of them are compatible with the S-100 buss used by Altair, IMSAI, and many others. They can be programmed by the Godbout Programming Service, or may be shipped unprogrammed.

Many computers, however, specifically suggested the 8080 software board. This 4K Econoram II is programmed with editor and assembler routines for the 8080, very much like the old Econoram; but this newer version has improved listings, which are a natural for getting any 8080 system up and running. For the benefit of any computers who did not receive word of the strike settlement, listed below are the boards offered by Godbout's:

#CK-002 (Smaller) Econoram IIT™; 2K X 8 of EROM. \$195.00
#CK-003 (Basic) Econoram IIT™; 4K X 8. \$250.00
#CK-004 (Bigger) Econoram IIT™; 8K X 8, configured as two separate 4K blocks. \$350.00
#CK-005 8080 Software Board A valuable first step in breaking away from machine language programming. \$265.00

TANTALUMS PICKED TO CLICK

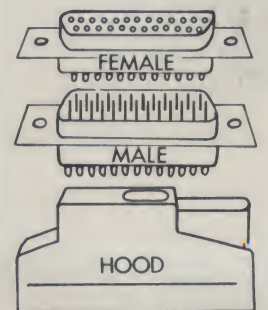
Tantalum capacitors, long a favorite of industrial contractors where price is no object, are famous for their low series resistance. Now, Godbout's is making them available to the electronics hobbyist at popular prices. The list below shows all tantalum capacitors known to be in existence at the Godbout warehouse.

#CT0.47U	.47 uF 35V	4/\$1.00
#CT2.2U	2.2 uF 20V	4/\$1.00
#CT2.7U	2.7 uF 20V	4/\$1.00
#CT3.3U	3.3 uF 15V	4/\$1.00
#CT4.7U	4.7 uF 10V	4/\$1.00
#CT22U	22 uF 10V	3/\$1.00
#CT33U	33 uF 10V	3/\$1.00
#CT39U	39 uF 10V	3/\$1.00
#CT47U	47 uF 6V	3/\$1.00

(advertisement)



Scientists discover missing link



Scientists have long puzzled over the "missing link" between computers and the outside world. Many have searched for this missing link, known in scientific circles as the DB-25 connector.

Extensive diggings at a certain manufacturer have resulted in the finding of this missing link by Godbout's trained researchers. They have isolated this missing link into three actual links, each of which performs a needed function in the crucial computer/outside world interface.

#CK-1004 - DB25P 25 pin RS - 232 connector, sub mini D type, male plug with plastic hood. \$3.95

#CK-1005 - DB25S 25 pin RS-232 connector, sub mini D type, female jack. \$3.95

#CK-1006 - DB25H plastic hood, which slips over the male plug to keep dust and glop from gumming up your connector. \$0.90

PARTS FORECAST

A cooling trend is forecast, with the warm TTL front being weakened by cooler, lower power ICs such as CMOS and low power Schottky. As this colder front moves in, we can expect lower prices and decreased emphasis on husky power supplies.

Low Power SCHOTTKY

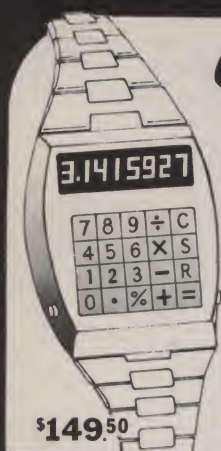
CMOS

4000	\$0.25	4037	0.50
4001	0.29	4040	1.50
4002	0.34	4041	0.85
4007	0.29	4042	0.85
4008	1.28	4043	0.60
4009	0.53	4044	0.60
4010	0.53	4047	1.63
4011	0.29	4049	0.50
4012	0.29	4050	0.50
4013	0.50	4051	1.03
4014	1.23	4052	1.03
4015	0.90	4053	1.03
4016	0.45	4060	1.48
4017	1.23	4066	0.58
4019	0.55	4069B/	
4020	1.50	74C04	0.33
4021	1.23	4070	0.60
4022	1.20	4071	0.33
4023	0.29	4073	0.33
4024	1.03	4075	0.33
4025	0.29	4076B/	
4027	0.75	74C173	1.63
4028	1.00	4081	0.33
4029	1.73	4116	0.50
4030	0.53	14511	2.00
4033	1.50		

74LS00	\$0.30	74LS151	0.95
74LS01	0.30	74LS155	1.38
74LS02	0.30	74LS157	0.95
74LS04	0.33	74LS160	1.40
74LS08	0.36	74LS161	1.40
74LS10	0.30	74LS162	1.40
74LS11	0.36	74LS163	1.40
74LS12	0.33	74LS168	1.87
74LS14	1.38	74LS169	1.87
74LS15	0.30	74LS173	1.65
74LS20	0.30	74LS174	1.25
74LS21	0.33	74LS175	1.15
74LS22	0.33	74LS195	1.30
74LS26	0.43	74LS240	1.88
74LS27	0.36	74LS257	1.25
74LS30	0.30	74LS258	1.25
74LS32	0.38	74LS266	0.53
74LS37	0.45	74LS283	1.20
74LS38	0.45	74LS365/	
74LS42	0.98	80LS95	0.75
74LS47	1.00	80LS96	0.75
74LS48	0.98	80LS97	0.75
74LS74	0.50	74LS367/	
74LS75	0.68	80LS98	0.75
74LS76	0.50	74LS368/	
74LS86	0.50	80LS98	0.75
74LS109	0.50	74LS386	0.55
74LS125	0.63	81LS95	1.13
74LS126	0.63	81LS96	1.13
74LS132	1.25	81LS97	1.13
74LS138	1.10	81LS98	1.13
74LS139	1.15		

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CALCULATOR WRIST WATCH

Designed for the on the go executive, that individual who has to make those on the spot decisions.

Handsome gold tone stainless steel watch features space age micro-circuitry. The MOS integrated circuit contains the equivalent of more than 10,000 transistors.

This LED wrist watch displays date, time, elapse seconds and also functions as an eight digit calculator with memory. Information stored in memory can be recalled at any later date, even weeks or months. Use this memory feature to store phone numbers, parking stall location or flight departure time.

Manufactured by one of California's leading aerospace contractors. Because of the discount price we have agreed not to publish the manufacturer's name.

Includes batteries, jewelry case and 18-month factory warranty.

\$149.50

ELECTRONIC ENTERTAINMENT CENTER

Tennis-Handball Hockey-Smash

Action-packed color entertainment for the whole family. Adjustable skill level controls allow players of all ages to compete in tennis, hockey and handball. This four game entertainment center turns your television into a video play-mat.

On screen scoring, live action sound and true component color makes this video center an excellent buy at only \$24.88. Complete with antenna box and AC adapter.

Color \$24.88

HEXADECIMAL KEYBOARD

Maxi-Switch hexadecimal keyboards are designed for microcomputer systems that require 4-bit output in standard hex code.

Each assembly consists of 16 hermetically sealed reed switches and TTL "one shot" debounce circuitry.

Reliable low friction acetal resin plungers are credited for the smooth operation and long life of this premium keyboard.

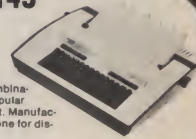
Requires single +5 volt supply.

\$29.95

TELETYPE MODEL 43

New from Teletype, the Model 43 is capable of printing 132 ASCII characters per line. Send and receive data at 10 or 30 words per second. Keyboard generates all 128 ASCII code combinations. RS-232 interface, same as the popular Model 33. Data sheet sent upon request. Manufacturer suggested price \$1377.00, telephone for discount and availability.

We also have for sale a limited quantity of used Model 35's. Priced at only \$449.50



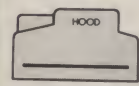
DIGITAL ALARM CLOCK

Completely Assembled \$19.95



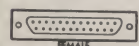
Walnut-grained decorator clock features large 7" LED display which is driven by the new National MM5385 alarm clock chip. Preset 24-hour alarm function allows you to awaken at the same time each morning without resetting. Upon reaching the wake-up time, the clock's loudspeaker emits a gentle tone. Touch the snooze button and doze off for an additional 9 minutes of sleep. Clock also functions as a ten-minute elapse timer. "Alarm Set" indicator, AM/PM display.

CONNECTORS



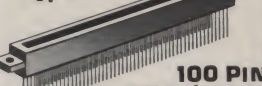
RS-232

DB25P male plug & hood \$3.95



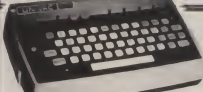
DB25S female \$3.95

\$4.98



100 PIN IMSAI/ALTair Edge Connector

Altair, Imsai compatible gold plated, dual 50 (125 contacts) three tier wire wrap edge connector. 3 for \$13.50

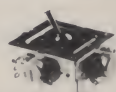


\$24.88

SPERRY UNIVAC KEYBOARD

The famous Sperry Univac 1710 Hollerith keyboard assembly is now available from California Industrial for only \$24.88. The ideal computer input device for accountants and mathematicians. The numeric keys are placed on the lower three rows to resemble a ten key adding machine. This format allows one handed numeric data entry. Original cost was \$385. Used but guaranteed in excellent condition. Complete with documentation.

JOYSTICK \$5.50



This joystick feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Perfect for television games, quad stereo and radio controlled aircraft.

FREE

MANUAL GRAPHITE DISPLAY GENERATOR

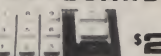
Modern technology has pioneered the development of the unique character printer. Our Manual Graphite Display Generator has the capability of producing the full upper and lower case ASCII set. Self-contained cursor assembly allows the operator to eliminate erroneously entered information. Each unit is manufactured to strict tolerances as prescribed by standards set forth by California Industrial. One free with every order.

\$4.98 10 for \$45.

Scotch BRAND DISKETTES IBM 3740 series and compatible drives



CALCULATOR KEYBOARD



\$2.98

Ideal for keyless entry systems, burglar alarms, Touch Tone or hexadecimal computer input code.

\$3.98 Digital Clock



Manufactured for the Panasonic clock radio. The clock mechanism trips a microswitch upon reaching your preset wake-up time.

2708

\$24.95

8K UV Erasable MEMORY

SUPREMACY



BRIDGE RECTIFIER MOTOROLA 12 Amp. 50v.

\$3.50



BNC CABLE 15 feet of RG-58U connector at ends

intel 2102AL 1k RAM 450ns \$1.19 Lowest Price Anywhere

7400	13	7476	39
7401	19	7479	3.95
7402	19	7480	7.9
7403	19	7482	9.9
7404	19	7483	9.9
7405	19	7485	9.9
7406	19	7486	3.40
7407	25	7489	2.79
7408	25	7490	4.9
7409	25	7491	9.9
7410	19	7492	4.9
7411	25	7493	4.9
7412	35	7494	7.9
7413	49	7495	7.9
7414	79	7496	7.9
7416	39	7497	3.95
7417	39	74100	1.19
7420	19	74107	3.9
7422	49	74109	4.9
7423	19	74110	1.79
7425	39	74116	1.99
7426	39	74120	1.79
7427	39	74121	3.9
7428	49	74122	6.9
7429	39	74123	6.9
7430	25	74125	5.9
7433	39	74126	6.9
7437	39	74129	4.9
7438	39	74132	9.9
7439	39	74136	9.9
7440	39	74141	9.9
7441	89	74145	9.9
7442	59	74148	2.49
7443	79	74148	1.19
7445	89	74150	1.19
7446	89	74151	9.9
7447	99	74153	8.9
7448	99	74154	8.9
7450	25	74155	9.9
7451	25	74156	1.29
7453	25	74157	9.9
7454	25	74159	2.99
7456	25	74160	1.19
7470	25	74161	1.19
7472	39	74162	1.49
7473	39	74163	9.9
7474	35	74163	9.9
7475	49		

74184	1.19	4049	79		
74185	1.19	4050	79		
74186	1.19	4051	1.99		
74187	4.99	4052	1.49		
74170	2.49	4053	2.19		
74173	1.49	4060	3.19		
74174	1.19	4066	1.19	1702	5.95
74175	99	4069	49	82s23	2.95
74176	99	4071	49	82s123	2.95
74177	99	4077	79	2102-1	1.79
74180	99	4081	49	21102	1.19
74181	2.49				
74282	99				
74184	1.99				
		CPU's		CLOCK's	

LM741 .09*

300H	79	340T-1	1.79
300H1	39	350N	9.9
300H2	39	350N1	9.9
300H3	39	350N2	9.9
300H4	39	350N3	9.9
300H5	39	350N4	9.9
300H6	39	350N5	9.9
300H7	39	350N6	9.9
300H8	39	350N7	9.9
300H9	39	350N8	9.9
300H10	39	350N9	9.9
300H11	39	350N10	9.9
300H12	39	350N11	9.9
300H13	39	350N12	9.9
300H14	39	350N13	9.9
300H15	39	350N14	9.9
300H16	39	350N15	9.9
300H17	39	350N16	9.9
300H18	39	350N17	9.9
300H19	39	350N18	9.9
300H20	39	350N19	9.9
300H21	39	350N20	9.9
300H22	39	350N21	9.9
300H23	39	350N22	9.9
300H24	39	350N23	9.9
300H25	39	350N24	9.9
300H26	39	350N25	9.9
300H27	39	350N26	9.9
300H28	39	350N27	9.9
300H29	39	350N28	9.9
300H30	39	350N29	9.9
300H31	39	350N30	9.9
300H32	39	350N31	9.9
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300H37	39	350N36	9.9
300H38	39	350N37	9.9
300H39	39	350N38	9.9
300H40	39	350N39	9.9
300H41	39	350N40	9.9
300H42	39	350N41	9.9
300H43	39	350N42	9.9
300H44	39	350N43	9.9
300H45	39	350N44	9.9
300H46	39	350N45	9.9
300H47	39	350N46	9.9
300H48	39	350N47	9.9
300H49	39	350N48	9.9
300H50	39	350N49	9.9
300H51	39	350N50	9.9
300H52	39	350N51	9.9
300H53	39	350N52	9.9
300H54	39	350N53	9.9
300H55	39	350N54	9.9
300H56	39	350N55	9.9
300H57	39	350N56	9.9
300H58	39	350N57	9.9
300H59	39	350N58	9.9
300H60	39	350N59	9.9
300H61	39	350N60	9.9
300H62	39	350N61	9.9
300H63	39	350N62	9.9
300H64	39	350N63	9.9
300H65	39	350N64	9.9
300H66	39	350N65	9.9
300H67	39	350N66	9.9
300H68	39	350N67	9.9
300H69	39	350N68	9.9
300H70	39	350N69	9.9
300H71	39	350N70	9.9
300H72	39	350N71	9.9
300H73	39	350N72	9.9
300H74	39	350N73	9.9
300H75	39	350N74	9.9
300H76	39	350N75	9.9
300H77	39	350N76	9.9
300H78	39	350N77	9.9
300H79	39	350N78	9.9
300H80	39	350N79	9.9
300H81	39	350N80	9.9
300H82	39	350N81	9.9
300H83	39	350N82	9.9
300H84	39	350N83	9.9
300H85	39	350N84	9.9
300H86	39	350N85	9.9
300H87	39	350N86	9.9
300H88	39	350N87	9.9
300H89	39	350N88	9.9
300H90	39	350N89	9.9
300H91	39	350N90	9.9
300H92	39	350N91	9.9
300H93	39	350N92	9.9
300H94	39	350N93	9.9
300H95	39	350N94	9.9
300H96	39	350N95	9.9
300H97	39	350N96	9.9
300H98	39	350N97	9.9
300H99	39	350N98	9.9
300H100	39	350N99	9.9

*We want to give them away — but our accountants won't let us. So instead we are selling them at cost. And therefore must limit the purchase of the SN7400 and the LM741 to 50 per customer.

commodore Personal Electronic Transactor

SYSTEM SPECIALS

ADDITIONS TO OUR GIANT SYSTEMS BUILDERS' CATALOG

★ CWS4 Hardcopy Terminal, Papertape I/O, SWTPC 6800 KIT



Here's one of our favorite combinations of microcomputer kits and our own low cost Olivetti (90-day used gear warranted) teletypewriters. The Olivetti 318 has all the features of a standard Teletype ASR 33, but we find it a lot easier to use than a teletype. In addition it has a 10-key numeric pad for fast input of numerics. Operating in low light levels is o.k. because the Olivetti has a small fluorescent light in the platen area. The machine is much quieter. Tape reader/punch operates at 10 char/sec, RS232, includes manual, parts available from Olivetti. In this package we are also including a Potter line filter for the SWTPC 6800 to insure years of trouble-free operation.

\$1216 complete, Olivetti alone \$875, Potter line Filter \$25, Shipping additional

★ CWS5 CRT, Digital Tape Drive I/O, 16K IMSAI KIT



This is a top notch system and the Techtran Digital Cassette tape drive (90-day used gear warranted) really establishes the system for solid heavy use. The drive features ASCII RS232 interface, off-line on-line operation, 110 to 300 baud, automatic BOT/EOT operation, 70,000 character capacity, runs directly from terminal. Combined with the 16K Imsai is our popular Hazeltine 1000, 12 x 80 CRT display (90-day used gear warranted), 64 character ASCII, 32 ASCII control codes: 110, 300 baud. With the Imsai are 20 Viking sockets for the motherboard, serial I/O, 16K RAM and cable A.

\$2493 complete, Hazeltine 1000 alone \$695, Techtran Digital Tape alone \$595 & shipping

THERMAL PRINTER

Compact table top unit ideal match in size to our Monitor



This NCR Thermal Printer is parallel but most models also have a Datapoint serial interface board too. 80 col, 96 char. Up to 30 cps

\$375 & shipping.

Terminal Prices Cut
Hazeltine 1000 now \$695
Built ADM-3 New now \$895

WRITTEN UP IN MAJOR MAGAZINES

Green Phosphor Video Monitor



*Ideal for SWTPC 64 or 1024 CRT terminal kit

*Add for a remote display

to your present terminal 16 MHz bandwidth, 12" CRT, up to 20 x 80 display, 1v peak-to-peak video input, solid state, 90-day used gear warranty

\$150 & \$25 Shipping

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- KEYBOARD KIT 95
- SWTPC 6800 395
- CT 64 TERMINAL KIT 325
- AC30 AUDIO INTERFCE ... 79.50
- GT61 99
- PP40 PRINTER 250
- SMOKE SIGNAL BROADCASTING 16K 595
- INTERCEPT JR. 12K RAM ... 145
- KIM-1 6502 245
- IMSAI 8080A KIT 22 SLOT .. \$751
- 4K MEMORY KIT 139
- SERIAL I/O KIT 125
- 65K RAM CARD 3899
- 32K RAM BOARD KIT 749
- ASSEMBLED 1099
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- ASSEMBLED 679
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★ Imsai - Altair "A" Compatible Kits ★

Z-80 CPU KIT COMPLETE - \$149. kit

Z-80 Chip & Manual \$49.95

Z-80 Manual - \$7.50 Separately

From the same people who brought you the \$89.95 4K RAM KIT. We were not the first to introduce an Imsai/Altair compatible Z-80 Card, but we do feel that ours has the best design and quality for the lowest price!
The advance features of the Z-80 such as an expanded set of 158 instructions, 8080A software compatibility, and operation from a single 5VDC supply, are all well known. What makes our card different is the extra care we took in the hardware design. The CPU card will always stop on an M1 state. We also generate TRUE SYNC on card, to insure that the rest of your system functions properly. Dynamic memory refresh and NMI are brought out for your use. Believe it or not, not all of our competitors have gone to the extra trouble of doing this.
As always this kit includes all parts, all sockets, and complete instructions for ease of assembly. Because of our past experience with our 4K kit we suggest that you order early. All orders will be shipped on a strict first come first served basis. Dealers inquiries welcome on this item. Kit includes Zilog Manual and all parts. Kit shipped with 2 MHz crystals.

**THE WHOLE
WORKS
\$89.95**

4K LOW POWER RAM BOARD KIT

Imsai and Altair 8080 plug in compatible. Uses low power static 21L02-1 500 ns. RAM'S. Fully buffered, drastically reduced power consumption, on board regulated, all sockets and parts included. Premium quality plated through PC Board.
For 250 ns RAM's add \$10.00

NEW! DESIGN CONSOLETT KIT - \$89.95

S.D. Sales announces the inexpensive way to beat the wire wrap jungle. Our latest kit gives you 124 solderless quick connect terminals, enough for eight 16 pin IC's and provides 50 x 8 common buss matrix. Has regulated +5VDC and +/- 15VDC, all at 1 AMP. Voltage regulation at 100%. Also includes a pulse generator variable from 10hz to 50mhz and .01 sec. to 100 nano seconds. Generator output is +5V. In kit form only and includes all parts, sockets; front panel measures 7 1/4" x 8 1/4", and hardware. case not available.

CAR/BOAT KIT *New Item!*
\$34.95
Music to your Ears!

MUSICAL HORN

Musical Horn Kit for car, boat, or home. Plays any tune from Mozart to Led Zeppelin. Change tunes in seconds; complete solid state electronics. Standard or custom tunes available at \$6.95 each (you supply us with the sheet music - we supply electronics for your favorite tune.) One song supplied with original order. Standard tunes available: DIXIE - EYES OF TEXAS - ON WISCONSIN - YANKEE DOODLE DANDY - NOTRE DAME FIGHT SONG - PINK PANTHER - AGGIE WAR SONG - ANCHORS AWAY - NEVER ON SUNDAY - BRIDGE OVER RIVER QUI - CANDY MAN.

HOME KIT
\$26.90

Home kit includes speaker which operates from your door bell. When door bell is pushed your favorite tune is played. Car/boat kit DOES NOT include speaker. Uses standard 8ohm PM speaker. Allow 4 weeks delivery on both kits.

Limited Quantity!
\$9.95 kit

6 DIGIT ALARM CLOCK KIT

We made a fantastic kit even better. Redesigned to take advantage of the latest advances in IC technology. Features: Litronix Dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). For P.C. board add \$3.00; AC XFMR add \$1.50. Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle - avoid the 5314!

NEW! WITH JUMBO LED READOUTS!

<small>1000 MFD Filter Caps Rated 35 WVDC. Up-right style with PC leads. Most popular value for hobbyists.</small>	<small>SLIDE SWITCH Assortment Our best seller. Includes miniature and standard sizes, single and multi-position units. All new.</small>	<small>POWER RESISTOR 15 OHM 25W BY CLAROSTAT</small>	<small>RESISTOR ASSORTMENT 1/4W 5% & 10% PC leads. A good mix of values! Special!</small>	<small>P.C. LEAD DIODES 1N4148/1N914</small>	<small>Just received a good mixed lot of National TO-92 plastic transistors, PNP & NPN, even a few FET's. 40-50% yield. Untested Asst.</small>	<small>DISC CAP ASSORTMENT P.C. Leads. At least 10 different values. Includes .001, .01, .05 plus other standard values.</small>
4/\$1.00	12/\$1.00	75¢ ea.	200/\$2.	100/\$2. 1N4002 - 1A 100 PIV	500/\$3.	60/\$1.00

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Huge Factory Purchase

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1.5 Micro-Seconds Access Time.

10/\$40. \$4.95 ea.

★ *Special!* ★

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28 PIN SOCKETS
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50WVDC
Computer Grade Cap
\$3.00 each

39 MFD
16 V Mallory
Electrolytic
15 for \$1.00

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Not only are our RAM'S faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02-1 Low Power and Super Fast RAM'S. Allow us to STRETCH your power supply farther and at the same time keep the wait light off!

500ns 8/\$12.95
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PC BOARDS
ALL TESTED;
FULL SPEC.*

IC's from XEROX

1402 A Shift Regulator - 50c
MH0025CN - 55c

7400 - 9c	7430 - 9c	7493 - 26c
7402 - 9c	7440 - 9c	74121 - 22c
7404 - 9c	7437 - 10c	74123 - 32c
7406 - 11c	7438 - 10c	74151 - 9c
7407 - 11c	7451 - 9c	74155 - 22c
7410 - 9c	7474 - 16c	74193 - 35c
7416 - 13c	7475 - 24c	8233 - 35c
7420 - 9c	7486 - 16c	Intel - 1302 - 45c

*Great
Buy!*

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40 PIN DIP. Everything you ever wanted in a counter chip. Features: Direct LED segment drive, single power supply (12 VDC TYPE), six decades up/down, pre-loadable counter, separate pre-loadable compare register with compare out-put. BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking. 1MHZ. count input frequency.

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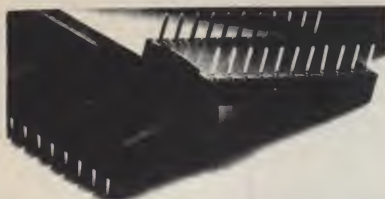
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High quality sockets for IC's and PC interconnections. Check our price and quality and you will see why TFI-TEK is fast becoming the leader in IC sockets.

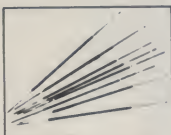
Low Profile DIP Solder Tail (Tin)

	1-9	10-24	25-100
SKT-0802 8 pin	.15	.15	.14
1402 14pin	.18	.17	.16
1602 16pin	.20	.19	.18
1802 18pin	.27	.26	.25
2002 20pin	.29	.28	.27
2202 22pin	.35	.34	.33
2402 24pin	.36	.35	.34
2802 28pin	.42	.41	.40
4002 40pin	.60	.57	.53



3 Level Wire Wrap Gold

	1-9	10-24	25-100
SKT-1400	.38	.37	.36
1600	.42	.41	.40
1800	.73	.65	.59
2400	1.00	.91	.83
4000	1.69	1.51	1.37



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Highest quality 30 ga. Kynar insulated silver plated wire for wrapping. Stripped 1" on both ends. Indicated lengths are lengths of insulated portion. Packed 100 per sturdy plastic vial or 1000 per poly bag. Compare our prices!!! Available in Black, Red, Yellow and Green. State color desired.

Length	Price per tube of 100	Price per bag of 1000
1"	\$1.48 (WW30VC-1)	\$11.84 (#WW30BK-1)
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6"	\$2.20 (WW30VC-6)	\$17.60 (#WW30BK-6)

ROLLS OF WIRE SAME AS ABOVE (30 ga. KYNAR)
100 ft...\$2.95 500ft...\$8.95 1000ft...\$14.95

WRAP WIRE SPECIAL FOR AUGUST

Special purchase of quality KYNAR insulated 30 ga. wire brings you a real bargain in pre-stripped wrapping wires. Available in blue color only. 1" and 2" insulation only.
1" insulation, blue, bag of 100 pieces.....\$.99
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RIBBON CABLE IC INTERCONNECTS

No. Of Pins	SINGLE END					
	6"	12"	18"	24"	36"	48"
14P	1.51	1.62	1.72	1.83	2.05	2.26
16P	1.64	1.76	1.87	1.99	2.21	2.44
24P	2.49	2.69	2.88	3.08	3.48	3.87
	DOUBLE END					
14P	2.76	2.87	2.97	3.08	3.30	3.51
16P	3.01	3.13	3.24	3.36	3.58	3.81
24P	4.55	4.75	4.94	5.14	5.54	5.93

AMPLANNY

Says

GET THE DROP ON THOSE WIRE WRAPPING PROBLEMS WITH WIRE AND TOOLS FROM TRI-TEK!!!!



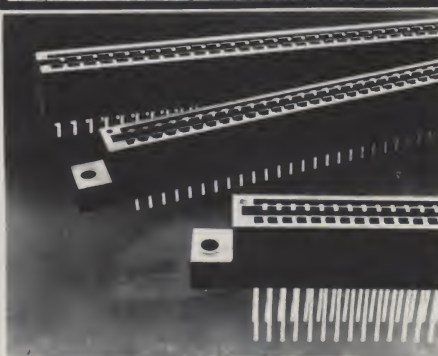
OK WIRE WRAP TOOLS
BW-630 GUN.....\$34.95
HW-30 Tool.....\$5.95
HW-30M Tool.....\$6.95
FREE, 50 roll of wire wrap wire with purchase of tool!

NEW BOOK

1977 IC MASTER. Latest edition of this classic reference work has 1263 pages of technical data, cross-references, second source listings, index of available application notes from the guys who make the parts! A free up-date service card to help keep your copy current is included. Beautifully bound in hard cover leather grained jacket. Want IC info? Here 'tis.....
1977 IC MASTER. (Includes shipping in USA).....\$38.88



PROFESSIONAL TEMPLATES-LOGIC SYMBOLS-Standard MIL806-B
3/4 Size.....\$3.50
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100 PIN MINICOMPUTER PC CONNECTORS
2 x 50 with .125" spacing. Solder tail or wrap terminals. PCC-100STN (solder) ...\$3.75 PCC-100WWN ...\$3.75 4/\$14.00

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The following items are available in large quantities Dealer or manufacturer inquiry is invited.

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C106F2... 50V, 4A SCR w/socket.....	3/\$1
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MCM6571A is an 8192-Bit Horizontal-Scan (Row select) character generator with shifted characters. It contains 128 characters in a 7X9 matrix, and has the capability of shifting certain characters that normally extend below the baseline, such as j,y,g,p and q. A 7-bit address code is used to select one of the characters.

Features:

- .Static operation
- .TTL compatability
- .CMOS compatability (5V)
- .Shifted character compatability
- .Includes Greek alphabet
- .Maximum access time =500ns

(See article in March '77 issue of 73 Magazine for applications including TV-Computer Interface)

MCM6571A.....	\$9.95
Specs.....	\$1.00

MM5320 TV SYNC GENERATOR I.C.

Generate all the sync pulses necessary for camera or video terminals. Use with MCM6571A in the TV-Computer interface. MM5320N.....\$18.80
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Think about it-- how many times have you seen an application for device with 7 segment readout if only you had the output in BCD? Calculators, clocks, timers and the like can now be read into your min'puter with minimum conversion hassel. CMOS for low power drain. Latched. MM74C915N...18 pin DIP.....\$2.99

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NOW- at last, a high current adjustable regulator. Same simple circuitry as the popular 78KGC. Needs only two external resistors to program to any voltage between +5 and 30V @ 5A output.
78HGKC.....\$13.95
Spec.....30

1N5393 200V, 1.5A Diode. Sturdy replacement for 1N4003 at a good savings.....15/\$1

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1/2" hexagonal metal jacket stud mount with 2" stab-on wire terminals. #KBS06..(Mfd. by G.I.).....89c

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4 pages of data......40
Crystal for the above.....\$4.95

- Accuracy: $\pm 0.05\%$ of Reading ± 1 Count
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- Up to 25 Conversions/s
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Single chip combines linear and CMOS digital to bring you the simplest yet DVM approach. Requiring only 4 external passive parts, this subsystem gives you: Auto polarity, auto zero, single voltage reference, 8 mW operation, overrange, underrange signals, 25 conversions per second and $\pm 0.05\%$ ± 1 count accuracy! 100 uV resolution. 24 Pin DIP. MC14433P.....with specs.....\$19.55



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Specifications

- Size: 21" wide x 21" deep x 8" high
- Power Input 115 Volt 60 Hz
- Interface: RS232
- Weight: 54 lbs. (Shipping Weight 65 lbs.)
- 15" Carriage
- Input/Output rates to 15 characters per second
- EBCD Code
- Half Duplex
- 132 Print Positions, 10 Pitch
- Can be used off-line

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Working
(Non Refurbed) \$695.
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Software to connect ASCII Output of 8080 Class
Processor to Selectric: Code \$25
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SELECTRIC TERMINAL (IBM Selectric Mechanism, Heavy Duty, Datel Electronics)

CARTERFONE MODEL 318 ASYNCH MODEM

- HARD WIRE
- TTY OR RS-232B INTERFACE
- ORIGINATE ONLY
- UP TO 300 BPS

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We ship prints with these.



CF328 Acoustic version of
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RS232 ITEM C-1
Male Connector **NEW**
\$2.50 Each
Solder Type Cover \$1.00 Each

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Modems: \$2.00 each; 2 for \$4.00 UPS
Small Items & Parts: \$2.00/order less than \$20.00;
\$4.00/order \$20.00 to \$100.00; \$6.00/order over
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Please specify exactly what you wish by order
number or name or both.
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All items subject to availability. Your money
returned if we are out of stock.
Items are either new (specified) or they are used
(tested or untested) and no other warranty is made
or implied.

DEC LSI-11 COMPONENTS

All Items NEW

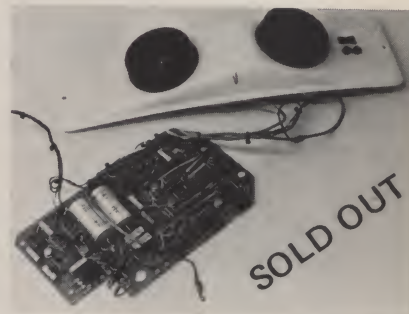
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PART NUMBER



		List	Selling
			Price
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PIO	(DRVII)	175	155
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(8KB)		625	550
PROM/ROM	(MRVIIIAA)		
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Physically fit into Model 33 Teletype. Manu-
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NEW PRICE
\$355.00 Each

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MODEL
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50 conductor, 28 gauge, 7 strands/conductor made by Spectra. Two conductors are paired & twisted and the flat ribbon made up of 25 pairs to give total of 50 conductor. May be peeled off in pairs if desired. Made twisted to cut down on "cross talk." Ideal for sandwiching PC boards allowing flexibility and working on both sides of the boards. Cost originally \$13.00/ft

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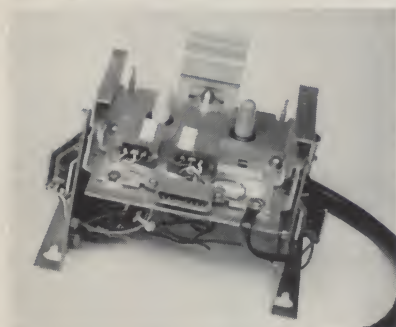
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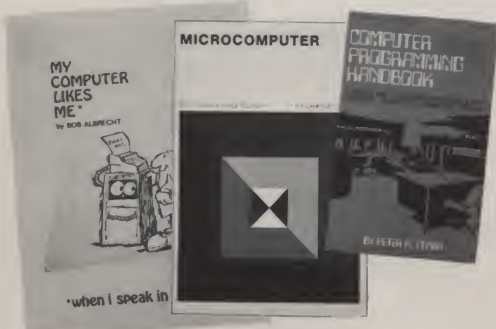
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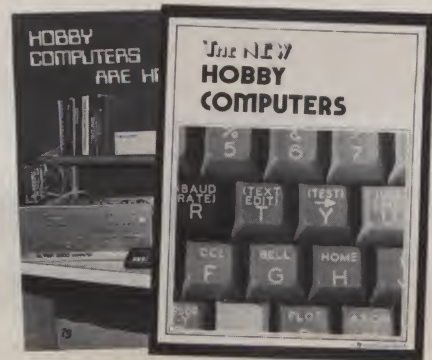
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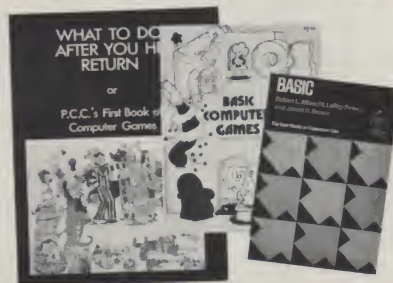
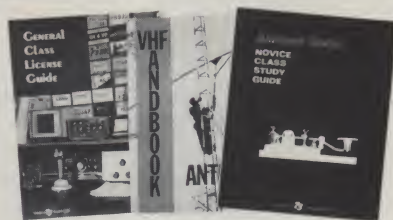
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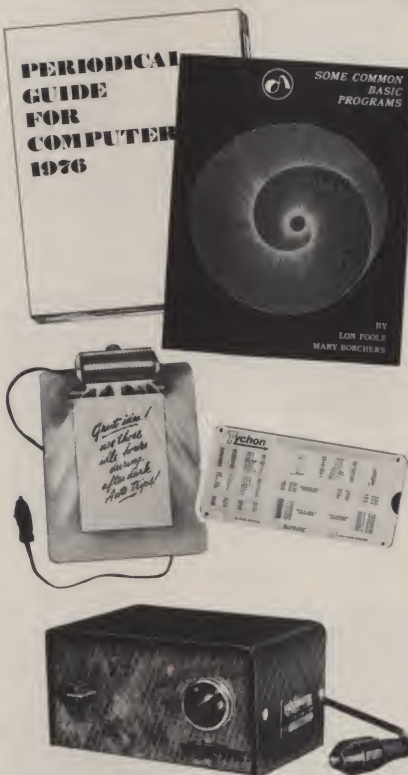
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Yes, there are computer articles in 73 ... a lot of them. There are also a lot of articles that computer hobbyists will be needing to read which are not exactly computer articles such as on regulated power supplies ... on making printed circuit boards ... on how various circuits work ... things like that which hardware men in particular need to read ... and which software people need even more, since they are a bit behind on hardware.

During the last year or so there have been over 300 pages of computer articles and nearly as many which are of interest to the average computerists.

In recent issues there have been articles on computerized satellite tracking (with software), RTTY using a uP, using old (inexpensive) Teletypes, building a Polymorphic video board, making instant PC

boards using the new color-key technique, the TTL one-shot, what computers can and can't do, a hamshack file handler (software), the bit explosion — 8-12-16?, backward branch the easy way with the 6800, the hexadecimal ... etc.

Any one of these articles could easily be worth the cost of a full year of 73. One good program could save you days of work. One good interface project could make an enormous difference. In general, 73 tries to present not too complicated construction projects ... things you can make in a day or two.

One of the fundamental policies is that no articles will be published in both 73 and Kilobaud. This is, in a way, unfair because it keeps some great computer articles away from computerists. You really must get both magazines to keep up to date with what is going on. When you subscribe to both you will not be getting duplication.

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GLOSSARY

Tim Barry

FLOAT: An input which is not being loaded or driven is said to be floating. Floating inputs pins are susceptible to noise, and they should always be pulled up or down to a known state. For example, unused TTL inputs will float at a logic high level. However, good design practice dictates that all unused TTL inputs be pulled up to V_{cc} through a pull-up resistor. Floating CMOS and low power Schottky inputs can be pulled up with or without resistors, but it is still important to force them into a known state.

FORMATTING: The general act of ordering information for input to or output from the computer or a peripheral. In particular, it is often used in the preparation of output that is to be used by the human operator. When you set up the output of your BASIC program to print a nice, easy-to-read table you are formatting the output.

Formatting is also used to refer to the preparation of magnetic media to accept data. For example, before a floppy disk can be used it must first be formatted with track and sector information required by the disk controller. After it is formatted, the disk can then be used for normal I/O operations.

MASK: A bit pattern used in conjunction with logic operations to test or modify bits in a data word. Masking is often used to modify the format of data being transferred between the computer and a peripheral. Consider the following bit pattern corresponding to the ASCII character "A" with odd parity:

1 1 0 0 0 0 1

Suppose we need to send that character to a device which requires even parity. We must mask bit seven (the parity bit) to a zero. To do that we use the mask 0 1 1 1 1 1 1 and the logic AND (\wedge) operation:

```

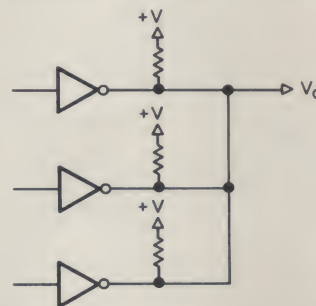
  1 1 0 0 0 0 1
 $\wedge$  0 1 1 1 1 1 1
  —————
  0 1 0 0 0 0 1

```

The selected bit has been masked to a zero and the rest of the data is unmodified.

STEPPING PULSE: A control signal used to cause an incremental action by some device external to the computer. Most often, a stepping pulse is used to control the motion of an incremental (or stepping) motor. Each time a pulse is received, the motor shaft rotates a fixed amount. Most high-speed paper tape readers have a stepping motor attached to the tape feed sprocket wheel. Each pulse received then causes the sprocket to step the tape forward one character.

WIRED OR: This technique, also known as *Dot OR*, *Implied OR*, *Virtual OR*, *OR Tied*, *Phantom OR*, and *Etch OR*, refers to the connecting together of the active outputs of two or more logic circuits. The result is an implied logic function. The term is actually a misnomer since, as shown in the example below, the output of the circuit will be high only when the outputs of all the ORed devices are high. This makes it a logic AND function. The technique is commonly used, but it is really best avoided. It makes isolation of the bad part in the system very difficult, and can lead to really difficult debugging.



	1	2	3	4	5	6	7
	KB						
8	9	10	11	12	13	14	15
C	A	L	E	N	D	A	R

Pomona CA

The Pomona Valley Chapter of the SCCS held its first meeting May 19, and discussed ideas for future programs and club activities.

Meetings are held from 7 to 9 p.m. at the Pomona Public Library, 625 S. Garey Ave., Pomona CA.

For additional information contact: Al Sutton, 4155 Oak Hollow Rd., Claremont CA 91711, (714) 593-6635 evenings.

Birmingham AL

The Birmingham Microprocessor Group, a club devoted to the interests of the computer hobbyists in and around the Birmingham area.

The club now has approximately 35 members, and meets on the fourth Sunday of each month at the South-

central Bell Company headquarters building, at 2 p.m. Contact Jim Anderson, 2931 Balmoral Rd., Birmingham, AL 35223 (205) 879-9630.

Nebraska

Omaha and Bellevue, Nebraska each have a computer club. The Omaha Microprocessor Amateur Hobbyist Association (O.M.A.H.A.) meets twice a month at Northern Natural Gas Company. MACH, in Bellevue, meets on the second Thursday of the month in the commercial Federal Building in Bellevue. For more information, contact O.M.A.H.A., c/o Rita Bianchi, S & DP — 4th floor, Northern Natural Gas, 2222 Dodge, Omaha NE 68102, or MACH c/o Thomas Smith, 2708 Calhoun Street, Bellevue NE 68005.

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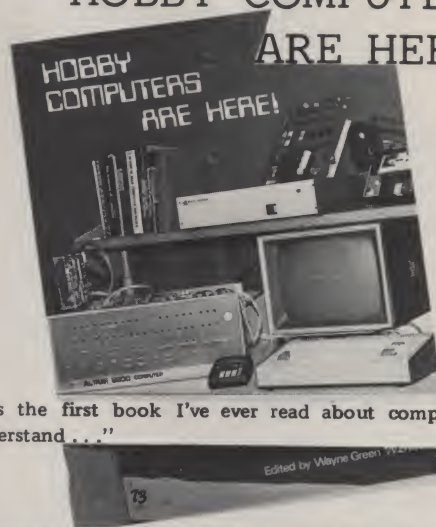
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